CIMRON
DIVISION

SERIES 7600
DIGITAL MULTIMETER
INSTRUCTION MANUAL

LEAR SIEGLER, INC.

SERIES 7600
DIGITAL MULTIMETER
INSTRUCTION MANUAL

CIMRON DIVISION of LEAR SIEGLER, INC.
1152 Morena Blvd, San Diego, California 92110

Area Code 714 - Phone 276-3200 - TWX 910-335-1196

TABLE OF CONTENTS

Section		Page
I	INTRODUCTION	1-1
	SCOPE	1-1
	GENERAL DESCRIPTION	1-1
	Capabilities Without Plug-In Accessories	1-1
	Capabilities With Plug-In Accessories	1-1
	Fabrication	1-2
II	SPECIFICATIONS	2-1
	INSTRUMENT WITHOUT PLUG-IN ACCESSORIES	2-1
	RATIO OPERATION	2-2
	WITH AC CONVERTER PLUG-IN ACCESSORY	2-2
	WITH DC PREAMPLIFIER PLUG-IN ACCESSORY	2-2
	WITH OHMS CONVERTER PLUG-IN ACCESSORY	2-3
III	PRELIMINARY INSPECTION AND OPERATION	3-1
	INSPECTION UPON RECEIPT	3-1
	OPERATING CONTROLS, INDICATORS, AND CONNECTORS	3-1
	OPERATIONAL CHECKOUT	3-1
IV	CALIBRATION AND SPECIFICATIONS VALIDATION	4-1
	GENERAL	4-1
	DC OPERATIONAL ADJUSTMENTS	4-1
	Sensitivity Adjustment	4-1
	Driver Balance Adjustment	4-2
	Fast-Up Adjustment	4-5
	Print Delay Adjustment (Model 7650 Only)	4-5
	DC CALIBRATION PROCEDURES	4-5
	SPECIFICATION VALIDATION	4-6
	DC Accuracy	4-6
	DC Input Resistance	4-6
	Common Mode Rejection	4-7
	Ratio Operation	4-8
	Floating Input	4-9
V	THEORY OF OPERATION	5-1
	GENERAL DESCRIPTION	5-1
	Basic DC Portion	5-1
	Ratio Operation	5-2
	Plug-In Accessories	5-2
	BLOCK DIAGRAM DESCRIPTION	5-2
	LOGIC DESCRIPTION	5-4
	EXTERNAL CABLES	5-6
	ASSEMBLY FUNCTIONAL DESCRIPTIONS	5-8
	Input Selector Subassembly	5-8
	Attenuator and Pre-Amp Assembly	5-8
	Amplifier Assembly	5-9
	Logic Driver Assembly	5-9
	Logic Matrix Assembly	5-10
	Decade Assemblies	5-10
	Range and Polarity Assembly	5-11

TABLE OF CONTENTS (CONTD)

Section		Page
V	THEORY OF OPERATION (CONT'D)	
	Reference and Ratio Assembly	5-12
	Potentiometer Assemblies	5-13
	Print Control Assembly - Model 7650 Only	5-14
	Print Output Assemblies - Model 7650 Only	5-14
	Power Supplies 1 and 2	5-15
VI	MAINTENANCE	6-1
	GENERAL MAINTENANCE INFORMATION	6-1
	TROUBLESHOOTING	6-1
	SEMICONDUCTOR PARAMETERS	6-1
	PARTS LIST	
	Attenuator and Preamplifier Assembly	6-2
	Amplifier Assembly	6-6
	Logic Driver Assembly	6-10
	Logic Matrix Assembly	6-15
	Units Through 1K Decade Assemblies	6-18
	10K Decade Assembly	6-22
	Range and Polarity Assembly	6-26
	Reference and Ratio Assembly	6-30
	"A" Potentiometer Assembly	6-33
	"B" Potentiometer Assembly	6-36
	Print Control Assembly	6-39
	Print Output "A" Assembly	6-42
	Print Output "B" Assembly	6-45
	Print Output "C" Assembly	6-48
	Print Output "D" Assembly	6-51
	Power Supply No. 1 Assembly	6-54
	Power Supply No. 2 Assembly	6-55
	Master Assembly	6-58
VII	RECOMMENDED SPARE PARTS	7-1
VIII	PLUG-IN ACCESSORIES	8-1
	GENERAL	8-1
	SECTION VIII SUBSECTIONS	8-1
	Preliminary Instructions	8-1
VIII-A	MODEL 985 POWER SUPPLY PLUG-IN ACCESSORY	8A-1
	OPERATIONAL CHECKOUT	8A-1
	THEORY OF OPERATION	8A-3
	General	8A-3
	Circuit Description	8A-3
	MAINTENANCE	8A-3
	Troubleshooting	8A-3
	Repair	8A-3
	Parts List	8A-4
VIII-B	MODELS 6770 AND 6771 AC CONVERTER PLUG-IN ACCESSORIES	8B-1
	ADJUSTMENT, CALIBRATION, AND SPECIFICATION VALIDATION	8B-1
	General	8B-1

TABLE OF CONTENTS (CONTD)

Section		Page
VIII-B	MODELS 6770 AND 6771 AC CONVERTER PLUG-IN ACCESSORIES (CONT'D)	
	Operational Adjustment	8B-1
	Test Equipment Accuracy	8B-2
	Range Calibration	8B-3
	Specification Validation	8B-4
	THEORY OF OPERATION	8B-5
	General	8B-5
	Circuit Description	8B-5
	MAINTENANCE	8B-6
	Troubleshooting	8B-6
	Repair	8B-6
	Parts List	8B-7
VIII-C	MODEL 6880 DC PREAMPLIFIER PLUG-IN ACCESSORY	8C-1
	ADJUSTMENT, CALIBRATION, AND SPECIFICATION VALIDATION	8C-1
	Zero and DC Balance Adjustment	8C-1
	Range Calibration	8C-1
	Specification Validation	8C-1
	THEORY OF OPERATION	8C-3
	General	8C-3
	Circuit Description	8C-4
	MAINTENANCE	8C-4
	Troubleshooting	8C-4
	Repair	8C-4
	Parts List	8C-5
VIII-D	MODEL 6990 OHMS CONVERTER PLUG-IN ACCESSORY	8D-1
	CALIBRATION, AND SPECIFICATION VALIDATION	8D-1
	Calibration	8D-1
	Specification Validation	8D-1
	THEORY OF OPERATION	8D-2
	General	8D-2
	Circuit Description	8D-2
	MAINTENANCE	8D-3
	Troubleshooting	8D-3
	Repair	8D-3
	Parts List	8D-4
APPENDIX		A-1

SECTION I

INTRODUCTION

SCOPE

This manual contains a general description, specifications, operation procedures, specifications validation procedures, theory of operation, logic description, maintenance procedures, and accessory descriptions, in that order, for the Cimron Series 7600 Digital Multimeter.

GENERAL DESCRIPTION

The Series 7600 Digital Multimeter consists of the Model 7630 and the Model 7650 instruments. Plug-in accessories are an available option for use with either model. The plug-in accessories are:

Model 985 Power Supply
Model 6770 AC Converter (30 Hz to 20 KHz)
Model 6771 AC Converter (30 Hz to 100 KHz)
Model 6880 DC Preamplifier
Model 6990 Ohms Converter

CAPABILITIES WITHOUT PLUG-IN ACCESSORIES

The instruments, without plug-in accessories, have DC voltage measurement and DC-DC voltage ratio measurement capabilities. In addition, the Model 7650 has a print output capability.

DC Voltage Measurement

The instruments measure DC voltages from 0.0000 to ±999.99 volts in three ranges of 9.9999, 99.999, and 999.99 volts full scale. Voltage, range, and polarity are indicated on front panel indicators. Input is isolated from power line ground to provide high common mode rejection. Polarity is automatically indicated. The instrument range is selected either manually or automatically. When auto-ranging is selected, the instrument tracks the DC input signal and continuously indicates the voltage present at the input. The instrument logic is unique and flexible, being able to select one of several routes to achieve balance in a short time.

DC-DC Ratio Measurement

When the ratio mode of operation is selected, the instrument indicates the ratio of the DC input signal to an external DC reference voltage, which may be any value from ±1.0000 volt to ±100.00 volts. The three ranges of 1:1, 10:1, and 100:1 are selected manually with a front panel control. The external reference polarity is selected automatically by the instrument.

Print Output

Connectors on the rear panel of the Model 7650 provide isolated contact closures between terminals for a printout of the front panel indication and an end of conversion signal (print command). The 10-line decimal coded data output is suitable for use by a digital printer or other recording device. Various BCD outputs are available upon special order.

CAPABILITIES WITH PLUG-IN ACCESSORIES

Certain plug-in accessories are available for use with the instruments. The plug-in accessories extend the capabilities of the instruments to include AC voltage, low level DC voltage (millivolts), and resistance measurements. Operation procedures, calibration procedures, theory of operation, and maintenance instructions are contained in Section VIII for each plug-in accessory.

AC Voltage Measurement

When used with the AC converter plug-in accessory the instrument measures AC voltages from 0.0000 to 999.99 volts. The AC converter has three full scale ranges of 9.9999, 99.999, and 999.99 volts AC.

DC Millivolt Measurement

When used with the DC preamplifier plug-in accessory, the instrument measures low level DC voltages from 0.0000 to ±999.99 millivolts. The DC preamplifier has three full scale ranges of 9.9999, 99.999, and 999.99 millivolts.

Resistance Measurement

When used with the ohms converter plug-in accessory the instrument measures resistances from .00000 to 9999.9 kilohms. The ohms converter has five full scale ranges of .99999, 9.9999, 99.999, 999.99, and 9999.9 kilohms.

FABRICATION

Virtually all components are mounted on plug-in printed circuit boards, providing ease in trouble shooting and maintenance not usually encountered in complex electronic test equipment.

Solid state components are used exclusively, with the exception of the critical circuitry associated with the digital potentiometer. The potentiometer circuit employs low-thermal switches as precision switching elements.

The low heat dissipation of the instrument permits a completely enclosed cabinet, thereby reducing dust and humidity factors.

SECTION II

SPECIFICATIONS

INSTRUMENT WITHOUT PLUG-IN ACCESSORIES

INPUT CIRCUIT	The signal input leads are floating and isolated from case, power line ground and printer output. A guard shield is employed to guarantee maximum input isolation and common mode rejection.
COMMON MODE REJECTION	1,000,000:1 (120 decibels) at DC and 100,000:1 (100 decibels) at 60 hertz. Signal input may be floated up to 500 volts DC or peak AC.
VOLTAGE RANGE	0.0000 to ±999.99 volts DC in three ranges of ±9.9999, ±99.999, and ±999.99 volts DC.
RANGE AND POLARITY SELECTION	Automatic plus manual front panel range control.
DISPLAY	Full five digits using long life readout tubes mounted behind non-reflecting polarizing screen.
ACCURACY	±(0.001% of full scale +0.01% of reading) for at least 90 days after calibration.
RESOLUTION	Varies as the 10K decade count changes. 10K Decade

10K Decade	Digits Resolution
0 or 1	1
2 or 3	2
4, 5, or 6	3
7, 8, or 9	5

INPUT RESISTANCE	In excess of 1,000 megohms at balance on 9.9999 volts DC range (instrument will measure voltage from a 10 megohm source); greater than 10 megohms independent of balance on 99.999 and 999.99 volts DC ranges.
OPERATING TEMPERATURE RANGE	0° to +50° centigrade; no lengthy warmup required; specified accuracy is obtained within thirty minutes.
DIGITAL OUTPUT (Model 7650)	The complete digital reading including range and polarity is available on rear mounted connectors. Output information is provided by isolated contacts of reed relays in ten line decimal code. BCD output models are also available. Contact ratings are 250 volts or 0.5 amperes with a 10 volt-amps maximum.
POWER REQUIREMENTS	105 to 125/210 to 250 volts, 50 to 400 hertz, approximately 35 volt-amps.

WEIGHT	36 pounds net; 40 pounds shipping.
SIZE	5-1/4 inches high x 19 inches wide x 18.3 inches deep. Suitable for standard 19 inch rack mounting.

RATIO OPERATION

RANGE	.00000:1 to 99.999:1 in three manual ranges of .99999:1, 9.9999:1 and 99.999:1.
ACCURACY	±(0.002% of full scale +0.005% of reading).
EXTERNAL REFERENCE RANGE	Less than ±1 volt, DC, to ±100 volts, DC.
INPUT RESISTANCE FOR EXTERNAL REFERENCE	100,000 ohms.
POLARITY	Automatic bipolar.
RESOLUTION (digits)	Measurement resolution $\left(\frac{10}{\text{Reference Voltage}}\right)$

WITH AC CONVERTER PLUG-IN ACCESSORY

RANGES	0.0000 to 999.99 volts AC in three manually selected ranges of 9.9999, 99.999 and 999.99 volts AC.
ACCURACY	±(0.05% of full scale + 0.05% of reading) from 30 hertz to 20 kilohertz. Model 6771 only - 20 KHz to 50 KHz: ±(0.05% of full scale + 0.25% of reading). Model 6771 only - 50 KHz to 100 KHz: ±(0.05% of full scale + 0.5% of reading).
INPUT RESISTANCE	Model 6771 9.9999 range: 2 megohms All ranges of Model 6770 and 99.999 and 999.99 ranges of Model 6771: 1 megohm.
FLOATING INPUT	Input to the connector is floated from case ground, power line ground and print output, if applicable, of the digital instrument.

WITH DC PREAMPLIFIER PLUG-IN ACCESSORY

RANGES	10 - ±0.0001 to ±9.9999 millivolts full scale. 100 - ±00.001 to ±99.999 millivolts full scale. 1K - ±000.01 to ±999.99 millivolts full scale.
ACCURACY	1K and 100 range: ±0.02% of reading, or ±1 digit, or ±2 microvolts, whichever is greatest. 10 range: ±0.03% of reading or ±2 microvolts, whichever is greater.
GAIN STABILITY	0.01% for at least 30 days.

LINEARITY

0.005% of full scale.

DRIFT

After 30 minutes warmup and under constant temperature conditions, drift will be less than ±5 microvolts or ±1 digit, whichever is greater, for a period of at least 7 days.

COMMON MODE REJECTION

Range	DC	60 Hz
10MV (X1000)	150 dB	140 dB
100MV (X100)	140 dB	130 dB
1KMV (X10)	130 dB	120 dB

WITH OHMS CONVERTER PLUG-IN ACCESSORY

RANGES

0 to 9.9999 megohms in five manually selectable ranges of 999.99 ohms, 9.9999 kilohms, 99.999 kilohms, 999.99 kilohms and 9.9999 megohms.

ACCURACY

1000 ohms, 10,000 ohms and 100,000 ohms ranges: ±0.005% of full scale or ±0.01% of reading.

1 megohm range: ±0.005% of full scale or ±0.02% of reading.

10 megohm range: ±0.005% of full scale or ±0.05% of reading.

STABILITY

0.01% of full scale for at least 24 hours on all ranges except the 10 megohm range which is 0.05% of full scale.

CONSTANT CURRENT RANGES

10 milliamperes, 1 milliampere, 100, 10 and 1 microampere.

CURRENT REGULATION

Output current will vary less than 0.01% for any output voltage from 0 to 10.0 volts.

SENSING

Two-wire sensing on all ranges, but includes zero control to compensate for a fixed lead resistance of up to 2 ohms.

SECTION III

PRELIMINARY INSPECTION AND OPERATION

INSPECTION UPON RECEIPT

The Series 7600 instruments are tested under severe environmental conditions prior to shipment. They are ready for immediate use upon receipt. Make the following checks, however, to ensure that the equipment has suffered no damage in shipment:

1. Inspect the shipping container prior to acceptance from the carrier. If damage to the container is evident, remove the instrument from the container and visually inspect for damage to instrument parts. Note any damage to the instrument and container on the carrier's receipt for the carrier's agent to sign. A claim for damage, with a copy to Cimron Division, Lear Siegler, Inc., must be filed with the carrier within 15 days following receipt of the instrument.

2. If damage is not apparent until after the instrument is accepted, a claim for concealed damage, with a copy to Cimron, must be filed with the carrier within 15 days following receipt of the instrument.

3. When a claim is filed against the carrier, all packaging material must be retained for inspection.

4. If the instrument is damaged in shipment, failure to file a claim against the carrier within the specified time, with a copy to Cimron, may nullify the Warranty in the event damage is reported to Cimron at a later date.

OPERATING CONTROLS, INDICATORS, AND CONNECTORS

All front and rear panel operating controls, indicators, and connectors are listed in table 3-1.

OPERATIONAL CHECKOUT

The operational checkout is a preliminary test of operation and does not confirm performance specifications. For specifications validation refer to Section IV. The operational checkout is performed as follows:

NOTE

The liability of Cimron under the warranty is negated if the instrument is improperly repaired. If trouble is experienced during the following test, refer to the appendix for warranty instructions before attempting repair.

1. Position the POWER switch to OFF.

2. Insert the signal input plug into the INPUT connector on the instrument. Connect all input leads together.

NOTE

Prior to performing the next step, switch S8 must be positioned to 115 or 230 as appropriate.

3. Insert the power cord into a three wire, 115/230 volts AC, 60 hertz, single phase power source.

4. Position the front panel controls as follows and observe that the POWER switch illuminates:

POWER	ON
RANGE	DC AUTO
SENSITIVITY	HI
FUNCTION	DC
FILTER	OUT
PRINT MODE (7650 only)	TRACK

5. Position the RANGE switch sequentially to 10, 100, and 1K and observe that the decimal point shifts to the proper position.

6. Position the RANGE switch to DC AUTO and connect a battery between the red and black leads of the signal input cable. Observe that the instrument indicates the voltage and polarity of the battery.

7. Reverse the polarity of the input voltage and observe that the instrument indicates the change.

8. Remove the signal input leads from the battery and connect them together. Observe that the instrument indicates 0.0000.

9. Position the FUNCTION switch to DC RATIO and sequentially position the RANGE switch to 1, 10, and 100. Observe that the decimal point shifts to the proper position.

10. Connect the test setup as shown in figure 3-1. Observe that the instrument automatically selects the polarity of the reference voltage and indicates the ratio of the input voltage to the reference voltage.

11. Change the position of the most significant increment of the voltage divider sequentially from one extreme to the other. Observe that either a positive or negative ratio indication can be made to appear on the instrument.

12. Remove the signal input leads from the test setup and connect them together.

13. Position the RANGE switch to 10 and observe that the instrument indicates 0.0000.

14. If the instrument contains an AC converter plug-in accessory, position the FUNCTION switch to AC. Observe that the front panel AC indicator illuminates and the instrument indicates 0.0000.

15. Position the RANGE switch sequentially to 10, 100, and 1K and observe that the decimal point shifts to the proper position.

NOTE

In step 16, if the instrument contains a Model 6770 AC Converter Plug-In Accessory, the AC voltage source output frequency range is between 30 Hz and 20 KHz. If the instrument contains a Model 6771 AC Converter Plug-In Accessory, the AC voltage source output frequency range is between 30 Hz and 100 KHz.

16. Connect an AC signal between the red and black leads of the signal input cable. Observe that the instrument indicates the value of the input voltage.

17. Remove the signal input leads from the AC signal source and connect them together. Position the RANGE switch to 10 and observe that the instrument indicates 0.0000.

18. If the instrument contains a DC preamplifier plug-in accessory, position the FUNCTION switch to MV and observe that the front panel MV indicator illuminates and the instrument indicates 0.0000. If the instrument does not indicate zero, adjust the front panel MV ZERO adjustment to obtain zero.

19. Position the RANGE switch sequentially to 10, 100, and 1K and observe that the decimal point shifts to the proper position.

20. Connect a millivolt signal between the red and black leads of the signal input cable. Observe that the instrument indicates the value and polarity of the input signal.

21. Reverse the polarity of the input voltage and observe that the instrument indicates the change.

22. Remove the signal input leads from the millivolt signal source and connect them together. Position the RANGE switch to 10 and observe that the instrument indicates 0.0000.

23. If the instrument contains an ohms converter plug-in accessory, position the FUNCTION switch to KΩ and the RANGE switch to 1. Observe that the front panel KΩ indicator illuminates and the instrument indicates .00000. If the instrument does not indicate zero, adjust the front panel KΩ ZERO adjustment to obtain zero.

24. Position the RANGE switch sequentially to 1, 10, 100, 1K, and 10K and observe that the decimal point shifts to the proper position.

25. Connect a resistor between the red and black leads of the signal input cable. Observe that the instrument indicates the value of the connected resistor.

26. Remove the input leads from the resistor and connect them together. Position the RANGE switch to 1 and observe that the instrument indicates .00000.

TABLE 3-1

CONTROLS, INDICATORS, AND CONNECTORS

CONTROL, INDICATOR OR CONNECTOR	POSITION OR CONDITION	FUNCTION
		FRONT PANEL
Polarity Indicator	+	Illuminated in DC, DC ratio, and mV functions when signal input is positive polarity.
	-	Illuminated in DC, DC ratio, and mV functions when signal input is negative polarity.
Decimal Indicator	.XXXXX	1 KΩ and 1:1 ratio ranges
	X.XXXX	10 KΩ, 10:1 ratio, 10 VDC or VAC, and 10 mV ranges.
	XX.XXX	100 KΩ, 100:1 ratio, 100 VDC or VAC, and 100 mV ranges.
	XXX.XX	1000 KΩ, 1000 VDC or VAC, and 1000 mV ranges.
	XXXX.X	10,000 KΩ range.
Numeral Indicators	Numerals in the Readout	Indicate value of the signal input, state of each decade assembly, position of reference potentiometer, and (7650 only) print output contact configuration.
FILTER (Slide Switch)	OUT	Extra input filtering is not provided.
	IN	Extra input filtering is provided.
(7650 only) PRINT MODE (3-Position Slide Switch)	AUTO	Instrument tracks input signal and upon reaching a null issues a print command signal through a rear connector.
	HOLD	Logic circuits are disabled.
	TRACK	Instrument tracks input signal but does not issue a print command.
(7650 only) PRINT MODE (2-Position Spring-loaded Slide Switch)	MANUAL	Causes a momentary contact closure resulting in a print command.
MV ZERO (Screwdriver Adjustment)	Variable	In the mV measuring function, with signal input leads shorted, adjusts front panel indication to all zeros.
MV (Function Indicator)	Illuminated	Instrument is in a mV measuring function and a DC preamplifier plug-in accessory is inserted in the instrument.
AC (Function Indicator)	Illuminated	Instrument is in an AC measuring function and an AC converter plug-in accessory is inserted in the instrument.

TABLE 3-1 (Cont'd)

CONTROLS, INDICATORS, AND CONNECTORS

CONTROL, INDICATOR OR CONNECTOR	POSITION OR CONDITION	FUNCTION
FRONT PANEL (Cont'd)		
KΩ (Function Indicator)	Illuminated	Instrument is in a resistance measuring function and an ohms converter plug-in accessory is inserted in the instrument.
KΩ ZERO (Screwdriver Adjustment)	Variable	In the resistance measuring function, with signal input leads shorted, adjusts front panel indication to all zeros.
POWER (Rocker Switch)	Top depressed and switch illuminated red.	AC power is applied to instrument.
	Bottom depressed and switch not illuminated	AC power is not applied to instrument.
RANGE (Rotary Switch)	DC AUTO	Instrument automatically ranges to provide proper input attenuation and correct decimal point location for maximum resolutions.
	1	1 KΩ and 1:1 ratio ranges.
	10	10 KΩ, 10:1 ratio, 10 VDC or VAC, and 10 mV ranges.
	100	100 KΩ, 100:1 ratio, 100 VDC or VAC, and 100 mV ranges.
	1K	1000 KΩ, 1000 VDC or VAC, and 1000 mV ranges.
	10K	10,000 KΩ range.
SENSITIVITY (Rotary Switch)	HI thru LO	HI equals 100 μV (maximum sensitivity). Sensitivity is decreased as the control is rotated toward LO.
FUNCTION (Rotary Switch)	DC RATIO	Instrument indicates the ratio of a DC signal input voltage to an external DC reference voltage.
	DC	Instrument measures DC voltages.
	AC	With an AC converter plug-in accessory, instrument measures AC voltages.
	MV	With a DC preamplifier plug-in accessory, instrument measures low level DC voltages (mV).
	KΩ	With an ohms converter plug-in accessory, instrument measures resistances.

TABLE 3-1 (Cont'd)

CONTROLS, INDICATORS, AND CONNECTORS

CONTROL, INDICATOR OR CONNECTOR	POSITION OR CONDITION	FUNCTION
FRONT PANEL (Cont'd)		
INPUT (8-Pin Plug)		Receives signal input cable. Connects either DC, AC, mV or resistance signal inputs and external DC reference voltages, if required, to instrument.
GROUND (Lug and Banana Jack Receptacle)		Connected to instrument case. May be driven externally to provide an extra shield around instrument.
REAR PANEL		
(7650 only) J2, J3, J4 (50-Terminal Receptacles)		Print output connectors. Contact closures are provided between terminals for recording of front panel numeral, decimal, polarity, and function indicators. Print command (end of conversion) contact closures are provided when applicable.
S8 (Slide Switch)	115	Used when the power plug is inserted into a 105 to 125 VAC power source.
	230	Used when the power plug is inserted into a 210 to 250 VAC power source.
FUSE (Receptacle)		Fuse is connected in series with the power input.

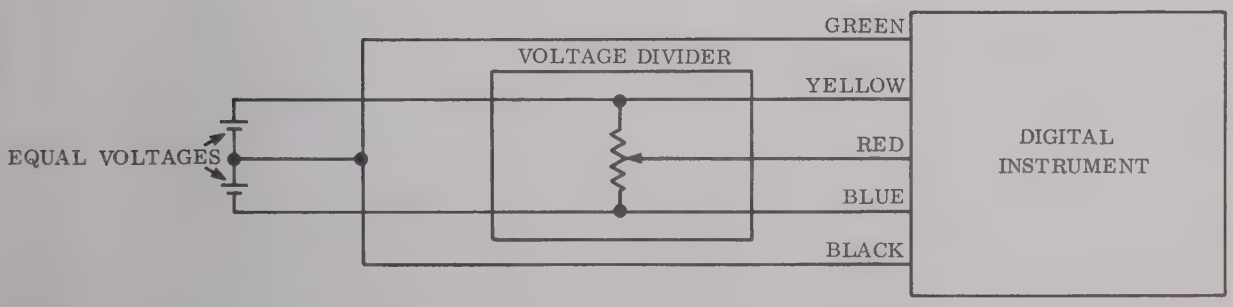


Figure 3-1. Ratio Operation Check Test Setup.

SECTION IV

CALIBRATION AND SPECIFICATIONS VALIDATION

GENERAL

Prior to calibration or specification validation, the instrument must be placed in the environment of the work area for sufficient time to allow the internal temperature to stabilize. A stabilizing time of one hour for every 10° centigrade change in temperature is required. Excessive temperature gradients resulting from a change in environment may cause thermal voltages to be generated which could affect calibration and specification validation. Power should be applied to the instrument for approximately 60 minutes prior to performing the following procedures.

This section contains operational adjustment procedures, calibration procedures, and specification validation procedures for the basic DC portion of the instrument. The procedures for the plug-in accessories are located in Section VIII. The operational adjustments do not affect the accuracy of the instrument but are necessary for proper operation. Due to interaction between adjustments, all procedures must be performed in the order given.

The initial setting of the instrument front panel controls is given in table 4-1. Changes from initial settings will be listed when applicable.

TABLE 4-1

Initial Setting of Front Panel Controls.

CONTROL	SETTING
POWER	ON
RANGE	10
SENSITIVITY	HI
FUNCTION	DC
FILTER	OUT
PRINT MODE (7650 only)	TRACK

DC OPERATIONAL ADJUSTMENTS

The following equipment is required to perform the DC operational adjustments:

1. Oscilloscope, Tektronix Model 502 or equivalent
2. DC power supply, Fluke Model 332A or equivalent
3. Voltage divider, ESI Model RV722 or equivalent

Figure 4-1 shows the test setup for the operational adjustments. It is recommended that the DC operational adjustments be made with a negative input to the instrument. Figure 4-2 shows the test points located on the bottom of the instrument. Figure 4-3 shows the internal adjustments.

1. Remove the top and bottom covers of the instrument. Do not remove the top shield showing the internal adjustments.

2. Connect the test setup as shown in figure 4-1.

NOTE

To eliminate ground loops, the oscilloscope must be floated by inserting a 3-wire to 2-wire adapter between the power cord plug and the power source.

3. Position the oscilloscope front panel controls for external AC trigger, 50 microseconds/centimeter time, 1 millivolt/centimeter upper beam sensitivity, and 10 volts/centimeter lower beam sensitivity.

SENSITIVITY ADJUSTMENT

1. Adjust the DC power supply output to -1.0000 volt.

2. Adjust the voltage divider to 00070 and allow the instrument to arrive at null.

3. Slowly increase and then decrease the setting of the voltage divider. Observe that either a positive or a negative pulse can be made to appear on the upper channel of the oscilloscope indication (UP, DOWN, figure 4-1).

4. Adjust the setting of the voltage divider so that neither a positive nor a negative pulse appears on the oscilloscope indication (NULL, figure 4-1). This is a true null.

5. Note the indication on the instrument front panel and the setting of the voltage divider.

6. Decrease the setting of the voltage divider by 00009 from the setting noted in step 5. For example, if the setting noted was 00072, the new setting would be 00063. If the front panel indication decreases by one or more digits, omit steps 7 through 12. It may decrease by more than one digit until the DRIVER BALANCE adjustment has been set.

7. Repeat steps 4 and 5.

8. Turn the SENSITIVITY adjustment (figure 4-3) five or six turns counterclockwise. Observe that the front panel indication has not changed.

9. Decrease the voltage divider setting by 00009.

10. Turn the SENSITIVITY adjustment slowly clockwise until the front panel indication decreases.

11. Adjust the voltage divider slightly to obtain a true null on the upper beam of the oscilloscope indication.

12. Decrease the voltage divider setting by 00009. Observe that the front panel indication decreases by one or more digits.

DRIVER BALANCE ADJUSTMENT

1. Adjust the voltage divider to 00070 and allow the instrument to arrive at null.

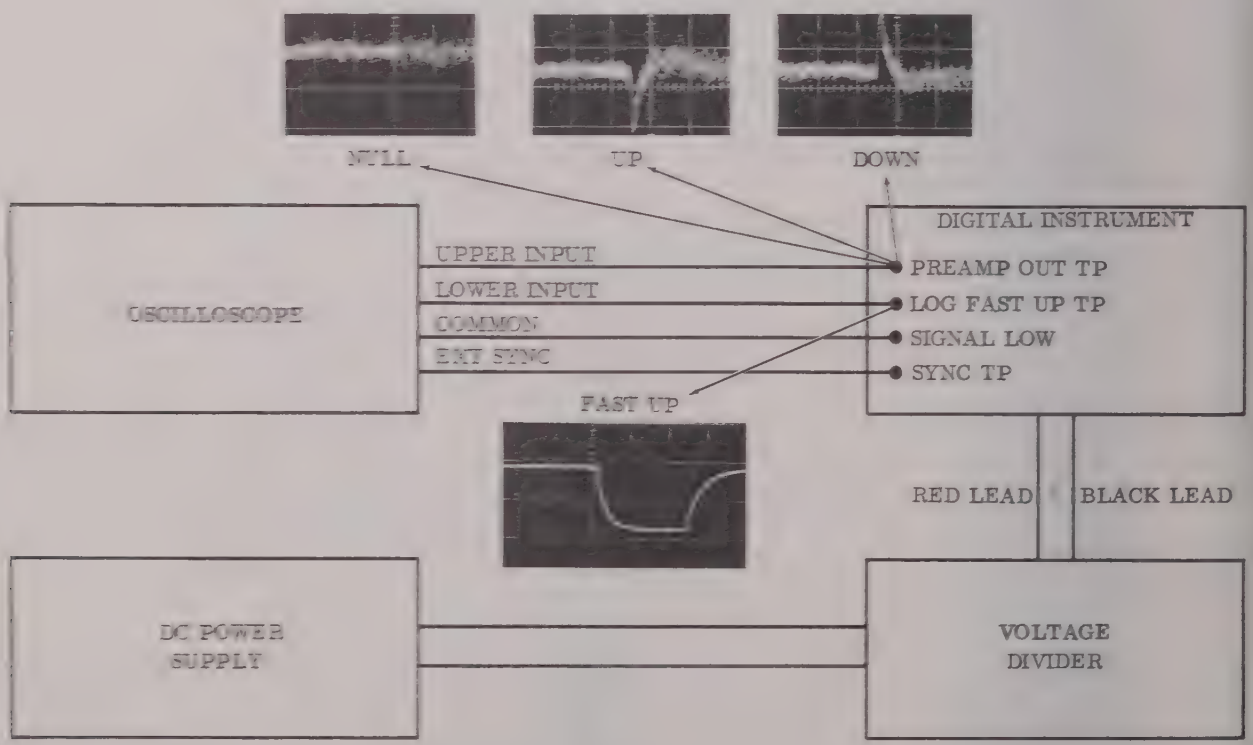


Figure 4-1. DC Test Setup.

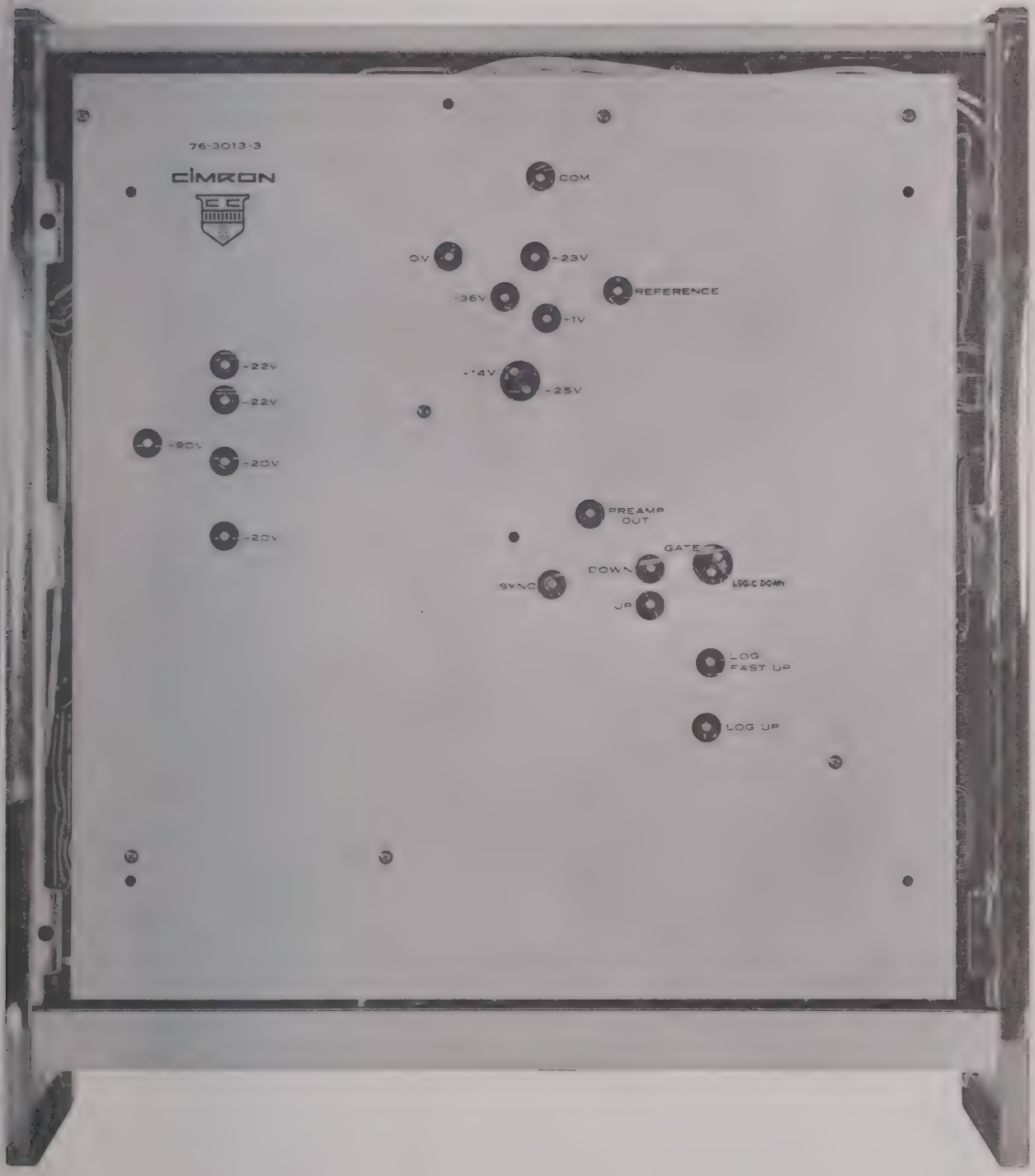


Figure 4-2. Bottom View Showing Test Points.

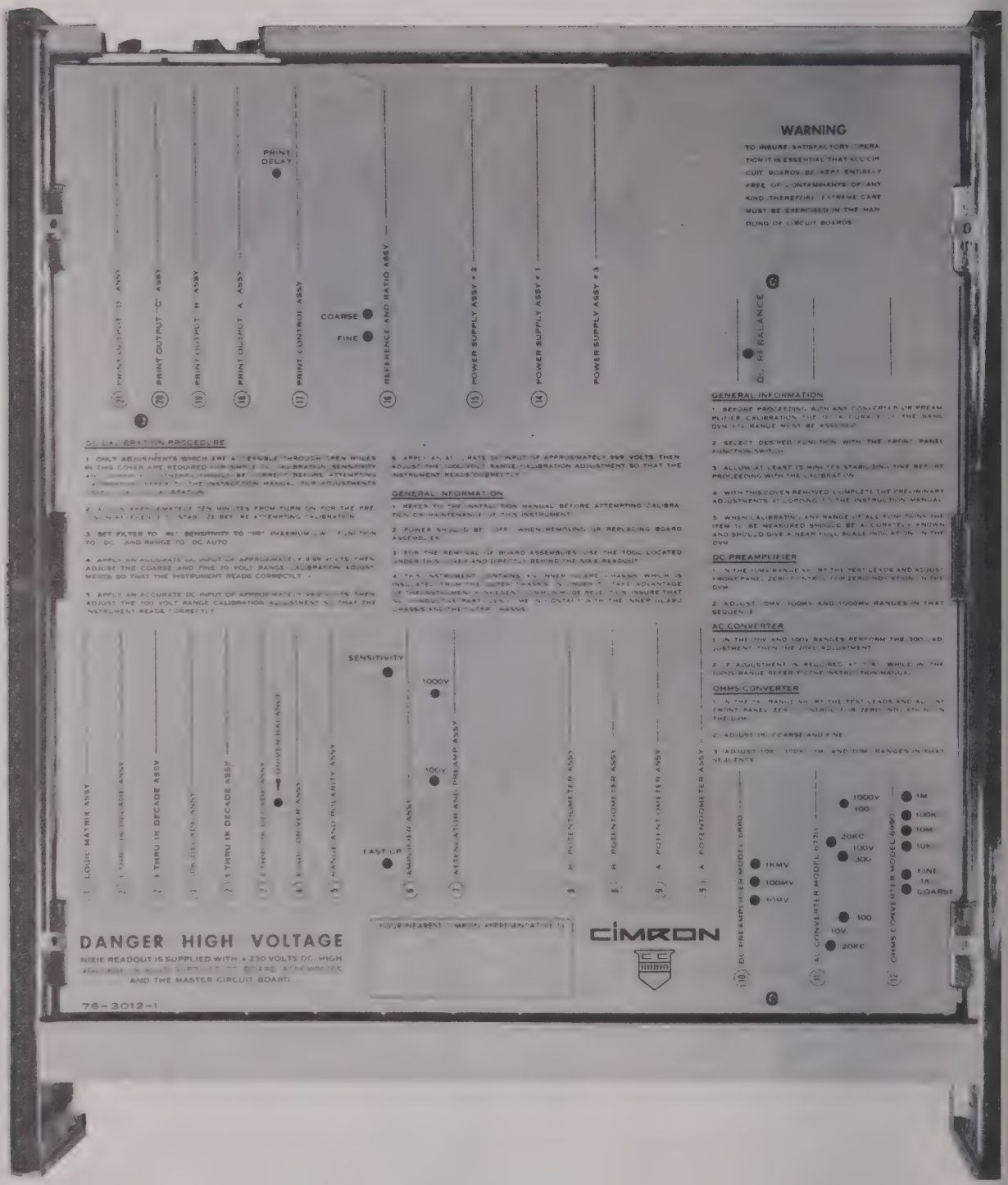


Figure 4-3. Internal Adjustments.

2. Adjust the setting of the voltage divider to obtain a true null on the upper beam of the oscilloscope indication. Note the indication on the instrument front panel and the setting of the voltage divider.

3. Increase the setting of the voltage divider by 00009. If the front panel indication increases by 0.0001 or 1 digit, omit steps 4 through 8.

4. Repeat step 2.

5. Turn the DRIVER BALANCE adjustment (figure 4-3) five or six turns counterclockwise. Observe that the instrument remains at a true null.

6. Increase the voltage divider setting by 00009.

7. Slowly turn the DRIVER BALANCE adjustment clockwise until the front panel indication increases by 0.0001 or one digit. Adjust the voltage divider to obtain a true null.

8. Increase the voltage divider setting by 00009. Observe that the front panel indication increases by 0.0001 or one digit.

FAST UP ADJUSTMENT

1. Adjust the voltage divider to 00070 and allow the instrument to arrive at null.

2. Using clip leads, short circuit both the UP and DOWN test points to COM (figure 4-2).

3. Adjust the voltage divider to obtain a true null and note the voltage divider setting.

4. Increase the voltage divider until a negative pulse appears on the lower channel of the oscilloscope indication (FAST UP, figure 4-1). If the negative pulse appears when the voltage divider has been increased by approximately 15000, omit steps 5 through 7.

5. Remove the clip leads and repeat steps 1 through 3.

6. Turn the FAST UP adjustment (figure 4-3) five or six turns counterclockwise. Increase the voltage divider setting by 15000.

7. Slowly turn the FAST UP adjustment clockwise until a negative pulse appears on the lower channel of the oscilloscope indication.

PRINT DELAY ADJUSTMENT (Model 7650 only)

When the instrument reaches a null and after a predetermined delay, a print (end of conversion) command is issued. The amount of delay is adjustable. The delay may be decreased by counterclockwise rotation of the PRINT DELAY adjustment (figure 4-3).

DC CALIBRATION PROCEDURES

A DC power supply, Fluke Model 332A or equivalent, is required to perform the DC calibration procedures. If an accurate DC power supply capable of 999.50 volts is not available, a lower voltage may be substituted. Note, however, that the accuracy of the calibration will be proportionately less as the supply voltage is decreased.

1. Remove the top cover of the instrument. Do not remove the top shield showing the internal adjustments.

2. Position the RANGE switch to AUTO and the other front panel controls to the initial setting (table 4-1).

3. Connect the test setup as shown in figure 4-4.

4. Adjust the DC power supply output to 9.9950 volts.

5. Sequentially adjust the COARSE and FINE adjustments (figure 4-3) to obtain a front panel indication of 9.9950.

6. Adjust the DC power supply output to 99.950 volts.

7. Adjust the 100V adjustment (figure 4-3) to obtain a front panel indication of 99.950.

8. Adjust the DC power supply output to 999.50 volts.

9. Adjust the 1000V adjustment (figure 4-3) to obtain a front panel indication of 999.50.

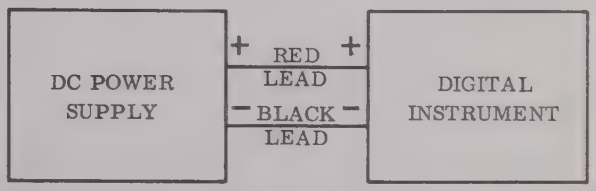


Figure 4-4. DC Calibration Test Setup.

SPECIFICATION VALIDATION

Prior to performing the specification validation procedures, ensure that the operational and calibration adjustments have been performed. Correct validation of the specifications depends upon the use of correct test equipment. Before rejecting an instrument for inability to validate the specifications, be certain the test equipment specifications are as given in the list of required equipment.

The following equipment is required to validate the DC specifications:

1. DC power supply, Kin Tel Model 321 or equivalent. If an accurate DC power supply capable of 999.50 volts is not available, a lower voltage may be substituted. Note, however, that the accuracy of the validation will be proportionately less as the supply voltage is decreased.
2. Voltage divider, ESI Model RV722 or equivalent
3. Audio voltage standard, Holt Model 323A or equivalent
4. Voltohmmeter (VOM), Simpson Model 260 or equivalent
5. Battery of approximately 1.5 volt
6. Resistors, 1 megohm, 1 kilohm, and 100 ohms
7. Capacitor, 1 microfarad
8. Switch, single-pole-double-throw
9. Switch, single-pole-single-throw

DC ACCURACY

The DC accuracy of the instrument is specified as ±(0.001% of full scale +0.01% of reading). The DC accuracy is validated by the following procedure:

1. Connect the test setup shown in figure 4-4, position the RANGE switch to DC AUTO, and position the other front panel controls to the initial setting (table 4-1).
2. Adjust the DC power supply output to +9.9950 volts DC and observe that the instrument front panel indication is +9.9950, ±0.0011 volt.
3. Adjust the DC power supply output to +99.950 volts DC and observe that the front panel indication is +99.950, ±00.011 volt.
4. Adjust the DC power supply output to +999.50 volts DC and observe that the front panel indication is +999.50, ±000.11 volt.

DC INPUT RESISTANCE

The DC input resistance of the instrument is specified as in excess of 1000 megohms at balance on 9.9999 volt DC range (instrument will measure voltage from a 10-megohm source); greater than 10 megohms independent of balance on 99.999 volt and 999.99 volt DC ranges. The DC input resistance is validated by measuring the voltage drop across a resistor in series with the signal input.

NOTE

Input shielding may be necessary in a noisy environment. A 1 microfarad capacitor is used as a shunt path for stray noise which would otherwise be developed across the high source impedance.

1. Connect the test setup shown in figure 4-5 and position the front panel controls to the initial setting (table 4-1).

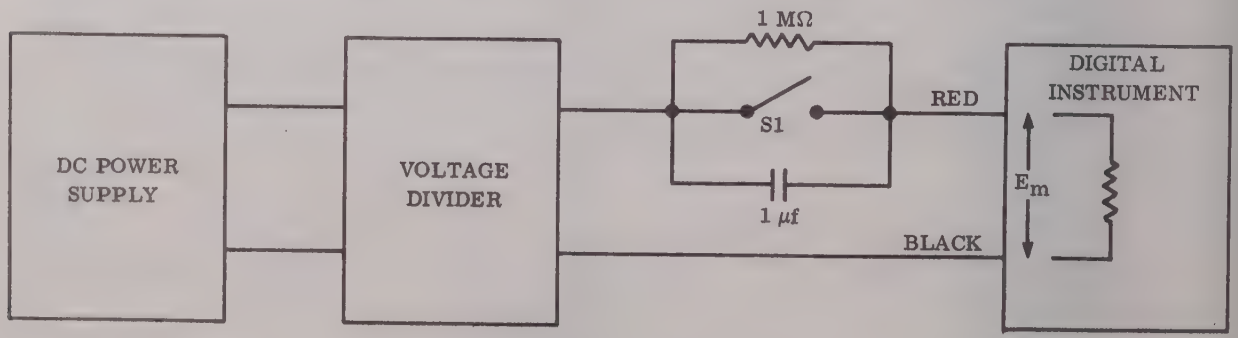


Figure 4-5. Input Resistance Validation Test Setup.

2. Adjust the DC power supply output to 10.000 volts.

3. Adjust the voltage divider setting to 99995 and observe that the front panel indication with S1 closed is 9.9995 volts.

4. Open S1 and observe that the front panel indication E_m with S1 open decreases by 100 digits (0.0100 volt) or less.

5. Close S1 and observe that the front panel indication is the same as step 3.

6. The voltage drop across the 1 megohm resistor, ΔE, is the indication in step 3 minus the indication in step 4. A ΔE of 0.0100 volt represents a 1000 megohm input resistance at DC as shown in steps 7 and 8.

7. Input current $= \frac{\Delta E}{10^6}$

8. Input resistance $= \frac{E_m}{\text{Input Current}}$

$$= \frac{E_m}{\frac{\Delta E}{10^6}}$$

$$= \frac{E_m}{\Delta E} \cdot 10^6 \Omega$$

COMMON MODE REJECTION

The following procedure is used for both AC and DC common mode rejection validation. The AC common mode voltage source is 60 hertz from an audio standard. The DC common mode voltage source is a DC power supply. If the common mode voltage is E_{cm} and the least significant digit change is defined as the error voltage E_e, the common mode voltage rejection ratio is expressed in decibels by the following formula:

$$\text{Common Mode Rejection} = 20 \log \frac{E_{cm}}{E_e}$$

1. Position the front panel controls to the initial setting (table 4-1).

2. Measure the resistance between signal low (black signal input lead) and chassis ground (GROUND binding post on the front panel). The VOM must indicate infinity. Correct any short or leakage between signal low and chassis ground before proceeding with the test.

3. Connect the test setup shown in figure 4-6 and adjust the output of the common mode voltage source to zero volts.

CAUTION

Do not increase the common mode voltage beyond 500 volts. If this caution is not observed, damage to the instrument may result.

4. Note the indication on the instrument front panel.

5. Slowly increase the output of the common mode voltage source until the least significant digit of the front panel indication becomes unstable.

6. Adjust the voltage divider for stabilization of the instrument.

7. Repeat steps 5 and 6 until the voltage divider is no longer able to stabilize the instrument.

8. Using table 4-2, determine the common mode rejection ratio of the instrument.

TABLE 4-2

Common Mode Rejection Ratio $\frac{E_{cm}}{E_e}$ in dB.

	E_e 0.0001V
*E_{cm}	
1V	80 dB
5V	94 dB
10V	100 dB
50V	114 dB
100V	120 dB
500V	134 dB

*E_{cm} is indicated as VDC or peak-to-peak VAC.

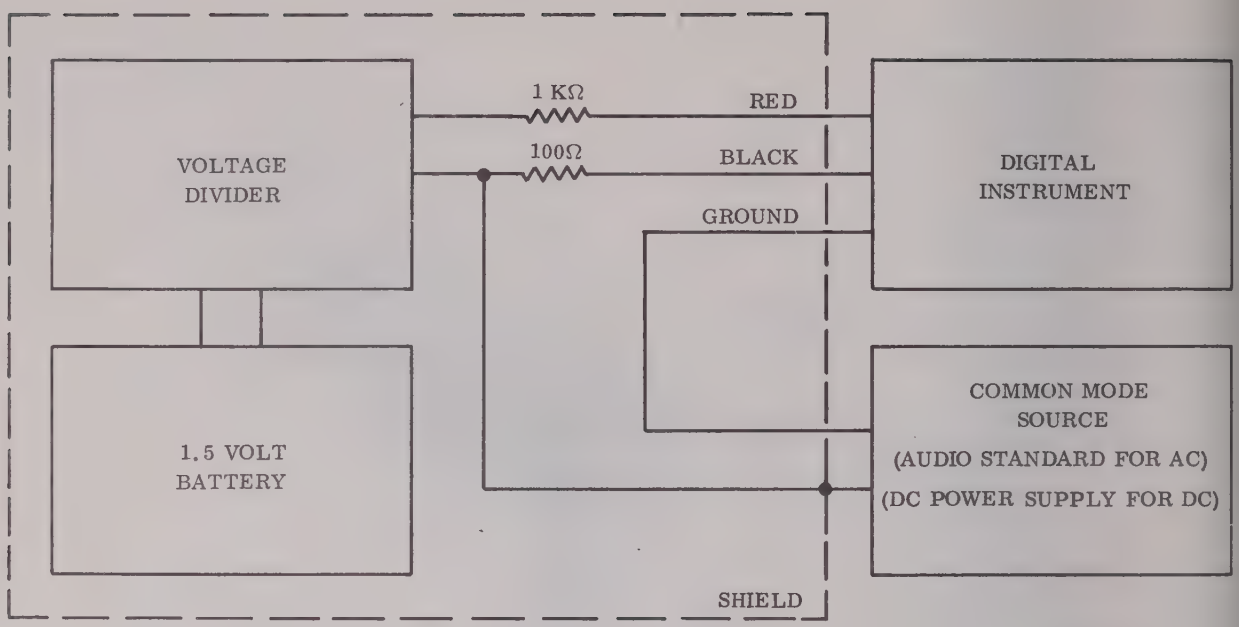


Figure 4-6. Common Mode Rejection Validation Test Setup.

RATIO OPERATION

The instrument is designed to compare an unknown DC input voltage with a known external DC reference voltage. The ratio is indicated directly as a quotient.

1. Connect the test setup shown in figure 4-7 with S1 connecting the voltage divider HI to EXT REF +.

2. Position the RANGE switch to 1, the FUNCTION switch to DC RATIO, and the other front panel controls to the initial setting (table 4-1).

3. Adjust the DC power supply output to 10.000 volts.

4. Adjust the voltage divider to 99990 and observe that the front panel indication is the same as the voltage divider setting within ±.00007.

5. Adjust the DC power supply output to 100.00 volts and observe that the front panel indication is the same as the voltage divider setting within ±.00007. The front panel SENSITIVITY control must be turned counterclockwise until a stable reading is obtained.

6. Adjust the DC power supply output to 10.000 volts and position the SENSITIVITY switch to HI.

7. Adjust the voltage divider to 55550 and observe that the front panel indication is the same as the voltage divider setting within ±.00005.

8. Adjust the voltage divider to 11110 and observe that the front panel indication is the same as the voltage divider setting within ±.00003.

9. Position S1 to connect the voltage divider HI to EXT REF -, and repeat steps 3 through 8 for a minus ratio.

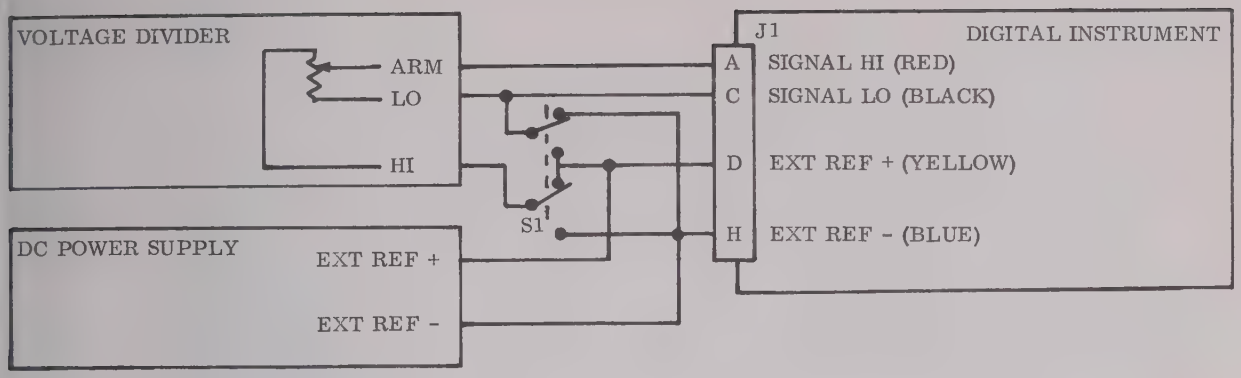


Figure 4-7. Ratio Operation Test Setup.

FLOATING INPUT

The five leads of the signal input cable are isolated from case, power line ground, and print output.

1. Connect the five signal input leads together.

2. Connect the VOM between the signal input leads and the case and observe that the resistance is indicated as infinity.

3. Position the RANGE switch to each position, observing at each position that the resistance is indicated as infinity.

4. Repeat step 3 with the FUNCTION switch positioned to DC, AC, MV, and KΩ.

5. Connect the VOM between the signal input leads and power line ground and repeat steps 3 and 4.

6. Model 7650 only - Connect the VOM between the signal input leads and the print output and repeat steps 3 and 4. The VOM should indicate infinity while the free VOM lead is slowly moved up and down on the terminals of the rear panel printout receptacles.

SECTION V

THEORY OF OPERATION

GENERAL DESCRIPTION

The instrument, with plug-in accessories, measures DC voltages, DC ratios, AC voltages, DC millivolts, and resistance. The instrument utilizes plug-in accessories to convert the AC, millivolt, or resistance inputs to DC voltages measurable by the basic DC portion of the instrument. The theory of operation of the plug-in accessories is contained in Section VIII.

BASIC DC PORTION

The basic DC portion of the instrument is essentially a closed loop servo system. A stable, internally-generated reference voltage is connected across a series of narrow-tolerance resistors which comprise the precision reference potentiometer. The logic of the instrument drives the potentiometer arm until the sum of the incremental voltage steps equal the unknown voltage value. The front panel indicators display the incremental changes of the precision voltage as they are sensed by the potentiometer arm. When a state of balance between the sum of the precision voltage incremental changes and the unknown voltage value is attained, the potentiometer arm stops moving. This is defined as a null condition. The value displayed by the front panel indicators represents the unknown voltage value.

Potentiometer positioning is accomplished by the servo system activated by the difference sensed in a voltage comparison circuit (figure 5-1). Voltage comparison is accomplished by an electromechanical chopper which alternately samples the unknown voltage and the reference voltage approximately 180 times per second. The chopper produces an output pulse that is proportional in amplitude to the difference between the two voltage values. The difference or error voltage sensed by the chopper is applied to a transistor error amplifier. From the amplifier the error signals are directed to one of three logic circuit inputs: UP, DOWN or FAST-UP drivers. The outputs of the three drivers are directed by the logic matrix to the appropriate binary decade assemblies, causing the potentiometer to null. Numeral indicators in the front panel indication monitor the position of the potentiometer arm and indicate the decimal equivalent of the input voltage.

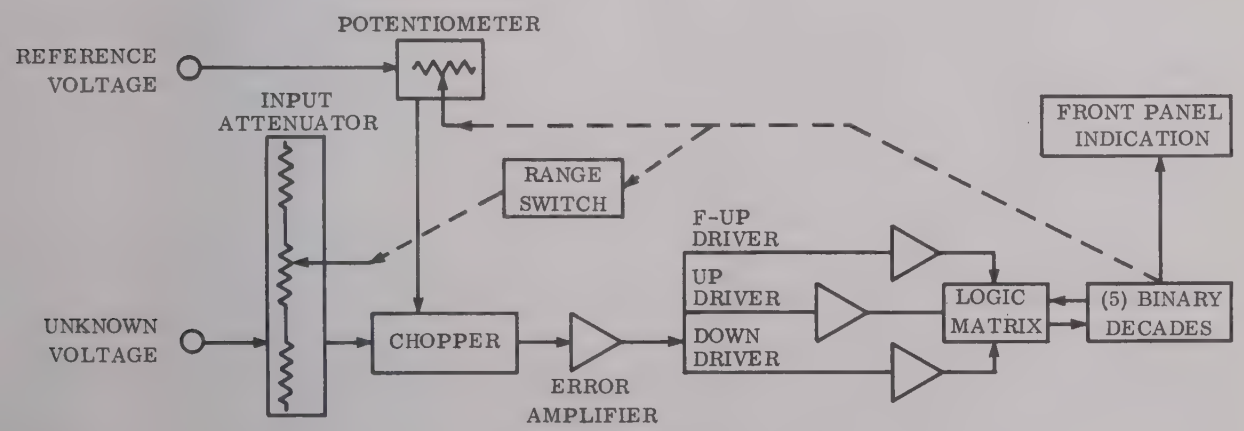


Figure 5-1. Simplified Block Diagram of Voltmeter Closed Loop Servo System.

RATIO OPERATION

In the ratio mode of operation, the instrument compares an unknown DC input voltage with a known external DC reference voltage. The internal reference voltage is disconnected. The instrument automatically selects the correct polarity of the external reference voltage to match the polarity of the unknown input voltage. The external reference voltage, which may vary from ±1 volt to ±100 volts DC, is connected across the precision reference potentiometer. The null is achieved in the same manner as described above. The decimal point position, however, indicates the arithmetical value of the ratio. For example, if the reference voltage is divided in half by the precision reference potentiometer, the front panel indication is .50000.

PLUG-IN ACCESSORIES

The AC Converter Plug-In Accessory converts the AC voltage input to a DC voltage proportional to the rms value of the AC voltage input. The DC Preamplifier Plug-In Accessory amplifies the millivolt input by a factor of 10, 100, or 1000 to provide a DC voltage of 10 volts full scale. The Ohms Converter Plug-In Accessory supplies a precision current through the unknown resistance to develop a voltage proportional to the value of the resistance. The DC voltage outputs of the plug-in accessories are measured by the basic DC portion of the instrument and indicated on the front panel as AC, MV, or KΩ values.

BLOCK DIAGRAM DESCRIPTION

Figure 5-2 is a block diagram of the instrument showing the relation of assemblies to each other. The diagram does not show the power supply, print control, print output, or plug-in accessories. The encircled numerals inside each block indicate the assembly slot number (refer to Section VI for additional details). For an explanation of the front and rear panel controls, indicators, and connector functions, refer to table 3-1.

The input to the basic DC portion of the instrument is connected to the Attenuator and Pre-amp Assembly. The basic range of the instrument is 10 volts full scale. An input voltage between 10.000 and 99.999 volts DC is attenuated by a factor of 10 and an input voltage between 100.00 and 999.99 volts DC is attenuated by a factor of 100 by the Attenuator and Pre-amp Assembly. The Attenuator and Pre-amp Assembly is controlled by the front panel RANGE switch and the Range and Polarity Assembly. An input filter is provided in the Attenuator and Pre-amp Assembly. Additional input filtering is available by positioning the front panel FILTER switch to IN. The filtered input voltage is compared with the reference voltage by the chopper located on the Attenuator and Pre-amp Assembly.

Chopper drive is provided by the Logic Driver Assembly. The output of the chopper, defined as the error signal, is amplified by the pre-amp portion of of the Attenuator and Pre-amp Assembly. The output of the pre-amp is connected to a coupling transformer. The secondary winding of the coupling transformer is controlled from the Range and Polarity Assembly through the Amplifier Assembly to maintain proper polarity relationship of the error voltage with the input voltage. The centertap of the secondary winding of the coupling transformer, A, is connected to the Amplifier Assembly through the front panel SENSITIVITY control, a potentiometer.

The Amplifier Assembly input signal is amplified and connected to the fast-up (F-UP) and the up-down amplifiers. The fast-up amplifier responds only to an increase of 1.5% or more of full scale. The up-down amplifier consists of two stages between which is connected the auto gain circuits. Auto gain commands from the 10K Decade Assembly reduce the sensitivity of the Amplifier Assembly when the instrument approaches the high end of full scale.

The Logic Driver Assembly converts the Amplifier Assembly output to fast-up, up or down driver pulses to drive the Logic Matrix Assembly. The Logic Driver Assembly also provides a path between the Logic Matrix Assembly and the Range and Polarity Assembly for up range commands. The Logic Driver Assembly delays consecutive up range commands to allow the input filter to stabilize. The oscillator drives a gate generator and provides chopper drive for the Attenuator and Pre-amp Assembly.

The Logic Matrix Assembly provides drive pulses to the Decade Assemblies, up range commands to the Logic Driver Assembly, and down range and polarity change commands to the Range and Polarity Assembly. The Logic Matrix Assembly receives range logic inputs from the Range and Polarity Assembly and decade logic inputs from the Decade Assemblies. The drive pulses received from the Logic Driver Assembly are directed to the Decade Assemblies which count up or

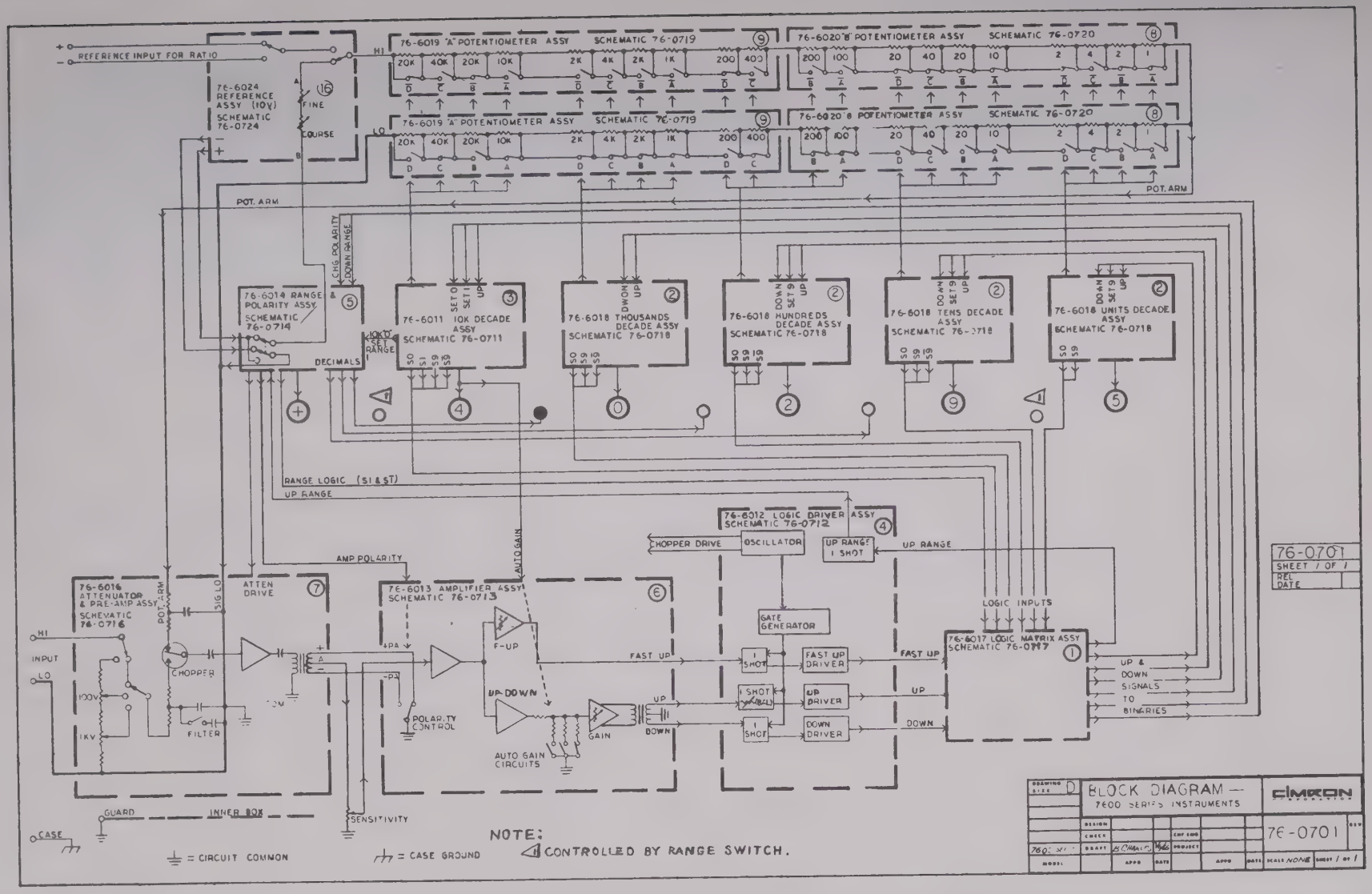


Figure 5-2. Instrument Block Diagram.

down. When the decade logic inputs indicate the necessity of a range change, an up range command is provided to the Logic Driver Assembly or a down range command is provided to the Range and Polarity Assembly. When the decade logic inputs indicate the necessity of a down range, and the range logic inputs indicate that the instrument is in the lowest range, a polarity change command is provided to the Range and Polarity Assembly.

The Decade Assemblies control the Potentiometer Assemblies, drive the front panel numeral indicators, and control the auto gain circuits on the Amplifier Assembly.

The Range and Polarity Assembly receives change range and change polarity commands from the Logic Matrix Assembly. Upon receipt of a change polarity command, the Range and Polarity Assembly changes the polarity of the reference voltage, the input to the Amplifier Assembly, and the front panel polarity indication. The DC AUTO position of the RANGE switch enables the Range and Polarity Assembly to automatically control the decimal indicator and range of the instrument when in the DC measuring function.

The Reference and Ratio Assembly provides either a stable 10-volt internal reference voltage or an external ratio reference voltage, as determined by the front panel FUNCTION switch position. The internal reference voltage source is located on the Reference and Ratio Assembly. The external ratio reference voltage is connected to the Reference and Ratio Assembly from an external source through the front panel INPUT connector. The polarity of either reference voltage is automatically selected by the Range and Polarity Assembly to match the input voltage.

The Potentiometer Assemblies receive the reference voltage from the Reference and Ratio Assembly and potentiometer drive pulses from the Decade Assemblies. The Decade Assemblies control the potentiometer arm position to select increments of the reference voltage until it is equal in amplitude to the input voltage. The reference voltage is connected as "POT ARM" to the chopper located on the Attenuator and Pre-amp Assembly. In figure 5-2 the contact configuration of the Potentiometer Assemblies is for a front panel indication of 4.0295.

LOGIC DESCRIPTION

The logic of the instrument is defined as the sequence of drive pulses required to cause the instrument to arrive at a null. Three types of basic drive pulses are used: down, up, and fast-up. The drive pulses effect down, up, and fast-up counting; automatic up and down ranging when the RANGE switch is in the DC AUTO position; and polarity changes.

Figure 5-3 is a logic diagram of the instrument. The gates are numbered and in the following discussion are shown in parentheses, e.g., (G1). If an input voltage of 0.0000 volt is slowly increased by a factor of less than 1.5% of full scale (G3), up drive pulses advance the count of the least significant (units) decade in single digit steps. When the units decade reaches a count of 9, the next up drive pulse advances the count to S9 (shift 9). The S9 condition of the units decade causes further up drive pulses (G6) to be directed to the tens decade. The tens, hundreds, thousands, and ten thousands decades (G7, G8, G9) count up in the same manner as the units decade. When all decades are in the S9 condition, the next up drive pulse becomes an up range pulse (G10). If the RANGE switch is positioned to DC AUTO the count changes to 99.999 (G13, G15, G18). The next up drive pulse becomes another up range pulse changing the count to 999.99 (G10, G12, G18). An additional up drive pulse forces the instrument into the 100-volt range and the count changes back to 99.999 (G10, G11, G15, G18). A regular alternation of the count between 999.99 and 99.999 indicates an input voltage in excess of the capabilities of the instrument.

Assume the input voltage to be 0.0000 volt. If the input signal is increased by a factor of 1.5% or more of full scale, fast-up drive pulses are produced along with the up drive pulses (G2 and G3). A fast-up drive pulse advances the count of the units decade directly to nine (G2). The next fast-up drive pulse does not affect the count but the accompanying up drive pulse advances the count to S9 (G3). The S9 condition causes further fast-up drive pulses and up drive pulses to be directed to the tens decade (G4 and G6). The tens and hundreds (G5) decades count fast-up in the same manner as the units decade. The thousands and ten thousands decades receive only the up drive pulses and not the fast-up drive pulses. If the front panel SENSITIVITY control is used to reduce sensitivity, the fast-up feature is inoperative because of dynamic range limitations.

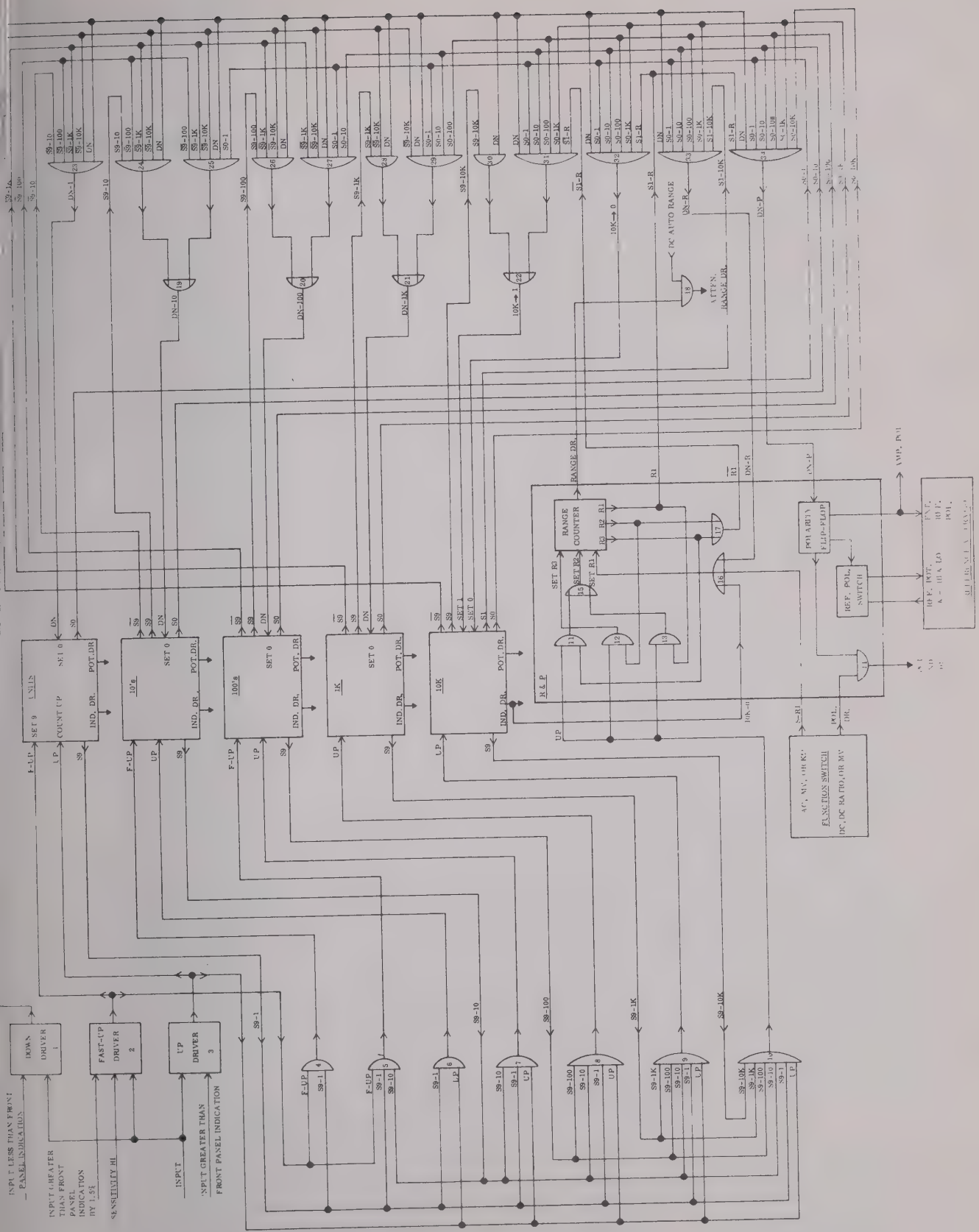


Figure 5-3. Instrument Logic Diagram.

If the input signal is decreased, down drive pulses are produced (G1). The exact order of the down count depends upon the conditions existing in the counting logic. The down drive pulses sequentially act upon the decades which are in an S9 condition, starting with the ten thousands decade and proceeding to the units decade. If the ten thousands decade is in an S9 condition the down drive pulse sets it to one (G30, G22). All other decades in an S9 condition, except the units decade, are set to zero (G28 and G21, G26 and G20, G24 and G19). When no decade other than the units decade remains in an S9 condition, the down drive pulses set the units decade to zero (G23). Next, starting with the tens decade and proceeding to the thousands decade, additional down drive pulses set each decade to zero when the higher number decades are in a $\overline{S9}$ state and the lower numbered decades are in a S0 state (G25 and G19, G27 and G20, and G29 and G21). If the Range and Polarity Assembly is in the 10-volt range (R1) the ten thousands decade is also set to zero (G32). If the Range and Polarity Assembly is in the 100-volt (R2) or 1000-volt (R3) range, the ten thousands decade is set to one (G17, G31, G22).

With a count of 10.000 or 100.00, the next down drive pulse becomes a down range pulse (G33, G16). A down range pulse sets the instrument to the 10-volt range from any higher range (G18). With a count of 1.0000, the next down drive pulse sets the ten thousands decade to zero (G32).

A down drive pulse sets the ten thousands decade to one while in the 100-volt or 1000-volt range in order to approach the input signal from the most sensitive range and maintain resolution. If, for example, the count is 200.00 and the input signal changes to 50 volts, the count changes to 100.00 then to 1.0000 and then counts up to 50.000. If the count went from 200.00 to 000.00 on the first down drive pulse, the instrument would then count up to 050.00 and resolution would not be maintained.

Other conditions can also cause the instrument to down range. If the RANGE switch is in the DC AUTO position and the ten thousands decade is in a zero count or if the FUNCTION switch is positioned to AC, MV, or KΩ, the instrument sets to the 10-volt range (G16, G18).

When the count reaches 0.0000, a down drive pulse becomes a change polarity pulse (G34, G14). This is indicated as a "DN-P" pulse. When the FUNCTION switch is positioned to DC, DC RATIO, or MV, the polarity indicator is activated. Polarity is not indicated for AC or KΩ.

NOTE

In tables 5-1 and 5-2, (S9) indicates the 9 is in a shift condition.

Table 5-1 shows a logic sequence of events involving all six types of pulses. As indicated in the FRONT PANEL INDICATION column, an input of -234.05 is changed to +234.05. The first events are a series of down drive pulses and a down range pulse to allow the instrument to change polarity. Then, because the error is greater than 1.5% of full scale, a series of fast-up and up drive pulses set all decades to an S9 state. The S9 state enables the instrument to up range. There is a delay between each up range pulse to permit stabilization of the input filter. The next event is a down drive pulse to set the ten thousands decade to one. The ten thousands decade then counts up to two. Each of the other decades first set to zero and then count up to the required number to achieve +234.05 and null.

Table 5-2 shows the counting logic for a small input change. Note that the thousands decade does not set to S9 but counts directly to four and then to five. The thousands decade does not receive fast-up drive pulses.

The instrument logic can be verified with a Logic Tester Assembly (Cimron Part No. 76-9504-1).

EXTERNAL CABLES

The Signal Input cable, Cimron Part Number 90-5004-3, (figure 5-4) plugs into the front panel INPUT connector. Each input lead is terminated with a banana plug connector. Alligator clip adapters are supplied with the cable. The alligator clips are constructed with gold plating for low-level measurement applications. The red alligator clip is Cimron Part Number 2-04711-2. The black alligator clip is Cimron Part Number 2-04711-0.

Connector P1 plugs into front panel INPUT connector J1 (diagram 76-0700, sheet 1).

The Power Input Cable is located on the rear panel of the instrument. The fuse (F1, diagram 76-0700, sheet 1) protects against voltage surges which might damage the instrument.

TABLE 5-1.

Counting Logic With Range and Polarity Change.

DRIVE PULSE	FRONT PANEL INDICATION	NUMBER OF PULSES
INPUT	-234.05, then reverse polarity to +234.05.	
DOWN	-234.00	1
DOWN	-230.00	1
DOWN	-200.00	1
DOWN	-100.00	1
DOWN RANGE	-1.0000	1
DOWN	-0.0000	1
CHANGE POLARITY	+0.0000	1
FAST-UP AND UP	+0.000(S9)	2
FAST-UP AND UP	+0.00(S9)(S9)	2
FAST-UP AND UP	+0.0(S9)(S9)(S9)	2
UP	+0.(S9)(S9)(S9)(S9)	10
UP	+(S9).(S9)(S9)(S9)(S9)	10
UP RANGE	+(S9)(S9).(S9)(S9)(S9)	1
UP RANGE	+(S9)(S9)(S9).(S9)(S9)	1
DOWN	+1(S9)(S9).(S9)(S9)	1
UP	+2(S9)(S9).(S9)(S9)	1
DOWN	+20(S9).(S9)(S9)	1
UP	+23(S9).(S9)(S9)	3
DOWN	+230.(S9)(S9)	1
UP	+234.(S9)(S9)	4
DOWN	+234.0(S9)	1
DOWN	+234.00	1
UP	+234.05	5, and null

TABLE 5-2.

Counting Logic for Small Voltage Change.

DRIVE PULSE	FRONT PANEL INDICATION	NUMBER OF PULSES
INPUT	+2.3456 changing to +2.5432.	
FAST-UP AND UP	+2.345(S9)	2
FAST-UP AND UP	+2.34(S9)(S9)	2
FAST-UP AND UP	+2.3(S9)(S9)(S9)	2
UP	+2.5(S9)(S9)(S9)	2
DOWN	+2.50(S9)(S9)	1
UP	+2.54(S9)(S9)	4
DOWN	+2.540(S9)	1
UP	+2.543(S9)	3
DOWN	+2.5430	1
UP	+2.5432	2, and null

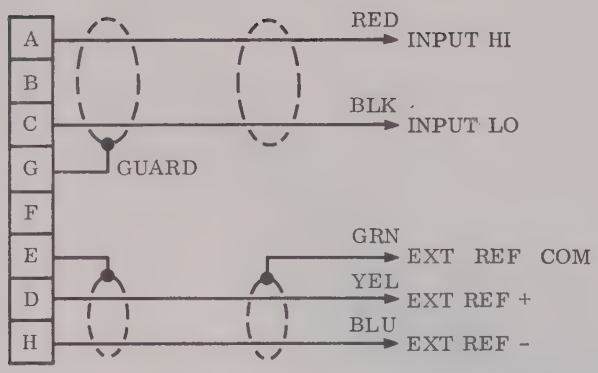


Figure 5-4. Signal Input Cable.

1. Attenuates signal input voltages greater than 10 volts.

2. Filters the signal input.

3. Compares the signal input voltage with a reference voltage and differentiates the result (error voltage).

4. Amplifies the error voltage and applies it to the Amplifier Assembly.

Signal input voltages from the front panel FUNCTION switch are applied across the INPUT HI and LO terminals.

Range commands are received at RANGE 1, RANGE 2, and RANGE 3 terminals from the front panel RANGE switch or from the Range and Polarity Assembly through the front panel RANGE switch.

ASSEMBLY FUNCTIONAL DESCRIPTIONS

GENERAL

The following descriptions relate the operation of each assembly and subassembly comprising the instrument. The drawings referenced in parenthesis after each assembly or subassembly title are the associated schematic diagrams located in Section VI, and should be referred to while reading the descriptions.

INPUT SELECTOR SUBASSEMBLY
(Diagram 76-0700, sheet 1)

The Input Selector Subassembly is mounted on the Master Assembly. In all modes of operation except AC, the input signal is routed through the normally closed contacts of relay K2 to the FUNCTION switch. When the FUNCTION switch is in the AC position, relay K2 is energized and the input signal is routed through the normally open contacts of K2 directly to the AC converter plug-in accessory.

ATTENUATOR AND PRE-AMP ASSEMBLY
(Diagram 76-0716)

The Attenuator and Pre-amp Assembly:

When the instrument is in the 10-volt range, coil L1 is energized and the contacts of switch S1 close, bypassing resistor R1. Resistor R2, together with neon lamps VR1 and VR2, is an over-voltage protective device. When the instrument is in the 100- or 1000-volt range, attenuation of a 100-volt or 1000-volt signal input to the basic 10-volt range is accomplished by energizing either coil L3 (100-volt range) or L2 (1000-volt range).

When the RANGE switch is positioned to DC AUTO and the FUNCTION switch is positioned to DC, switches S1, S2, and S3 are opened and closed automatically by the Range and Polarity Assembly as the instrument tracks the signal input.

When the FUNCTION switch is positioned to AC, MV, or KΩ, common is applied to terminal RANGE 1, locking the Attenuator and Pre-amp Assembly in the 10-volt range.

Additional signal input filtering is provided when the front panel FILTER switch is positioned to IN; energizing coil L4 by providing circuit common through terminal K5 and closing switch S4 contacts.

Chopper G1 compares the signal input voltage with a reference voltage approximately 180 times a second. Any resulting error voltage is present at the chopper output in the form of a square wave. The square wave is proportional in amplitude to the difference between the input and reference voltages and of the same

polarity as the difference. The chopper coil is energized from the Logic Driver Assembly across terminals 1 and 3.

The chopper output is amplified by approximately 20 decibels and applied across the + and - terminals to the Amplifier Assembly. The centertap of the secondary winding of transformer T1 is connected from terminal A through the front panel SENSITIVITY control to the Amplifier Assembly.

AMPLIFIER ASSEMBLY (Diagram 76-0713)

The Amplifier Assembly:

1. Maintains proper polarity relationship between signal input voltage and error voltage.
2. Provides amplified up and down outputs to the Logic Driver Assembly.
3. Provides a shortcut in logic for large up errors.
4. Reduces sensitivity when approaching high end of full scale.

Terminals + and - of the Attenuator and Pre-amp Assembly are connected through terminals +PA and -PA of the Amplifier Assembly to transistor switches Q2 and Q1, respectively.

An up error voltage must be negative in polarity and a down error voltage must be positive, regardless of the polarity of the signal input. Polarity commands are received at +P or -P terminals from the Range and Polarity Assembly. The polarity commands turn on either Q1 or Q2 to maintain proper polarity relationship between the signal input voltage and the error voltage. The + terminal of the secondary winding of transformer T1 of the Attenuator and Pre-amp Assembly is grounded to common for a positive signal input voltage and the - terminal is grounded for a negative signal input voltage.

The front panel SENSITIVITY control output (error voltage) is received at terminals B and C. The error voltage is approximately one millivolt at B for a one digit change in the signal input voltage.

Transistor Q6, the up-down amplifier, is turned on when a 1 millivolt per digit of error voltage is applied to terminal B. The output of Q6 is amplified approximately 60 decibels, and applied to the bases of transistors Q15 and Q16. Potentiometer R39, identified on the instrument top shield as SENSITIVITY, is the amplifier gain adjustment. Q15 provides up pulses and Q16 provides down pulses through the UP and DN terminals, respectively, to the Logic Driver Assembly.

Transistor Q4, the fast-up amplifier, provides amplified fast-up pulses through terminal F-UP to the Logic Driver Assembly. The fast-up circuit sets the instrument to full scale, providing a shortcut in the logic for large up errors (nominally 1500 digits).

The amplitude of the up, down, and fast-up pulses is nominally +1 volt. An up pulse is always provided when a fast-up pulse is provided.

Auto-gain control commands are received from the 10K Decade Assembly at terminals 2 through 9. The command consists of applying common to the terminal corresponding to the count of the 10K Decade Assembly.

The three auto gain attenuator sections are selected by transistors Q8, Q9, and Q10 which are controlled through terminals 2 through 9. The auto-gain circuit improves stability by reducing the sensitivity of the Amplifier Assembly when the 10K Decade Assembly approaches full scale.

LOGIC DRIVER ASSEMBLY (Diagram 76-0712)

The Logic Driver Assembly:

1. Provides chopper drive for the Attenuator and Pre-amp Assembly.
2. Amplifies and inverts up, down, and fast-up pulses and directs them to the Logic Matrix Assembly.
3. Provides a variable delay between consecutive up range pulses to allow the input filter to stabilize.

Transistors Q1 and Q2, identified as the OSCILLATOR, comprise an astable multivibrator. Approximately 180 times a second, the oscillator provides an output pulse of approximately +20 volt amplitude of one millisecond duration across terminals CH1 and CH3 to the chopper on the Attenuator and Pre-amp Assembly. Resistor R37 is a factory-set adjustment which controls the frequency of the oscillator.

Transistors Q3 and Q4, identified as the GATE FLIP-FLOP, comprise a bistable multivibrator. The gate flip-flop performs two functions:

1. Prevents up, down, and fast-up drivers from responding to noise transients.

2. Prevents either the up or down driver from responding while the other driver is responding.

The state of the gate flip-flop is changed by the oscillator and synchronized with the chopper. In one state the gate flip-flop disables the up, down, and fast-up drivers; in the other state the drivers are enabled. The enabled state is synchronized with the chopper to allow only the up, down, and fast-up pulses to pass, thereby eliminating response to noise transients.

When either the up driver or down driver is energized, it resets the gate flip-flop immediately. This prevents the other driver from responding until the gate flip-flop has been set to the enabled state again by the oscillator. The up driver always responds simultaneously with the fast-up driver, therefore the fast-up driver does not provide a reset command to the gate flip-flop.

On models with a print output, the gate flip-flop output is provided through terminal GATE to the Print Control Assembly. The Print Control Assembly grounds the gate flip-flop output during the print cycle, thereby disabling the up, down, and fast-up drivers and providing a hold on the instrument.

The up, down, and fast-up pulses are received from the Amplifier Assembly at terminals AMP UP, AMP DN, and AMP F-UP, respectively.

The three circuits identified as DOWN DRIVER, UP DRIVER, and FAST-UP DRIVER are monostable multivibrators followed by an amplifier transistor. The pulses are amplified approximately 30 decibels and applied through terminals LOG DN, LOG UP, and LOG F-UP to the Logic Matrix Assembly. Potentiometer R59, identified on the top shield of the instrument as DRIVER BALANCE, is adjusted to equalize the level at which the up and down drivers respond. The nominal amplitude of the drive pulses provided for the Logic Matrix Assembly is -28 volts. A connection between the collector of Q16 and the base of Q19 provides an interlock to prevent the fast-up driver from responding when only the up driver is required.

Up range commands at a nominal amplitude of -28 volts are received at terminal UP-R IN from the Logic Matrix Assembly.

The circuit identified as RANGE DRIVER delays consecutive up range pulses long enough to allow the input filter to stabilize. The front panel FILTER switch controls S1 through terminal K11 to allow a longer delay when the FILTER switch is positioned to IN. The range driver provides up range commands through terminal UP-R OUT to the Range and Polarity Assembly.

LOGIC MATRIX ASSEMBLY (Diagram 76-0717)

The Logic Matrix Assembly routes drive pulses from the Logic Driver Assembly to the Decade Assemblies, the Logic Driver Assembly, and the Range and Polarity Assembly.

The -28 volt down, up, and fast-up drive pulses are received from the Logic Driver Assembly at terminals DN-IN, UP-IN, and F-UP-IN, respectively.

The Decade Assemblies and the Range and Polarity Assembly provide logic inputs which enable the Logic Matrix Assembly to determine which assembly receives a particular drive pulse.

The logic inputs to the Matrix Assembly are received at terminals beginning with an "S", identified along the right margin of the diagram. The logic inputs have two states, go or no-go. A logic input in a no-go state is connected to common and all diodes connected to the logic input are forward biased. Negative drive pulses are accepted by the diodes and are grounded to common. A logic input in a go state is connected to an open circuit and the diodes connected to the logic input are unbiased. Negative drive pulses are not accepted by the diodes and are directed through terminals along the lower edge of the diagram to the appropriate inputs of the Logic Driver Assembly, Decade Assemblies, or Range and Polarity Assembly (figure 5-2). The logic sequence of events is described in the paragraph titled LOGIC DESCRIPTION.

DECADE ASSEMBLIES (Diagrams 76-0718 and 76-0711)

The Units, 10, 100, and 1K Decade Assemblies are identical and interchangeable (diagram 76-0718). The 10K Decade Assembly has different inputs and outputs than the other decade assemblies (diagram 76-0711).

All Decade Assemblies:

1. Count up or down as directed by the Logic Matrix Assembly.
2. Control the Potentiometer Assemblies.
3. Control the front panel numeral indicators.
4. Provide logic outputs to the Logic Matrix Assembly.

NOTE

All pulses mentioned in the following discussion have a nominal amplitude of -28 volts.

Up drive pulses are received at terminal UP from the Logic Matrix Assembly.

Each Decade Assembly contains a four-binary counter and an S9 binary. Up drive pulses cause the counter to count up in a 1-2-4-2' sequence. When the counter has reached the count of 9, the next up drive pulse changes the state of the S9 binary. The S9 binary provides logic outputs that enable the Logic Matrix Assembly to determine when to direct the next up drive pulse to the next higher Decade Assembly. When the 10K Decade Assembly has counted to the S9 state, the next up drive pulse from the Logic Matrix Assembly is directed to the Range and Polarity Assembly through the Logic Driver Assembly.

The Units, 10, and 100 Decade Assemblies receive fast-up drive pulses through terminal F-UP from the Logic Matrix Assembly. The fast-up drive pulse sets the Decade Assembly to the 9 state from any lower state. The next up pulse sets the assembly to the S9 state, thereby setting the assembly to full scale with two drive pulses instead of 11 and providing a shortcut in the logic. The 1K and 10K Decade Assemblies do not receive fast-up drive pulses.

All Decade Assemblies, except the 10K Decade Assembly, receive down drive pulses through terminal DN from the Logic Matrix Assembly. The down drive pulse sets the assembly to the 0 state from any other state.

The 10K Decade Assembly receives 10K-set-one and 10K-set-zero pulses at terminals 10K → 1 and 10K → 0 from the Logic Matrix Assembly. The 10K-set-one pulse sets the assembly to the 1 state from any other state except 0. The 10K-set-zero pulse sets the assembly to the 0 state from any other state.

All Decade Assemblies provide control commands for the Potentiometer Assemblies through terminals D, $\overline{D}$, C, $\overline{C}$, B, $\overline{B}$, A, and $\overline{A}$.

Each Decade Assembly contains ten driver transistors and a diode decoder. The diode decoder decodes the 1-2-4-2' BCD outputs of the counter into 10-line decimal data to operate the driver transistors. The driver transistors control the front panel numeral indicators through terminals 0 through 9.

The Units Decade Assembly provides to the Logic Matrix Assembly an S0-go logic output through terminal S0 when in the 0 state and an S9-go logic output through terminal S9 when in the S9 state.

The 10, 100, and 1K Decade Assemblies provide to the Logic Matrix Assembly an S0-go logic output through terminal S0 when in the 0 state, an S9-go logic output through terminal S9 when in the S9 state, and a $\overline{S9}$-go logic output through terminal $\overline{S9}$ when in the $\overline{S9}$ state.

The 10K Decade Assembly provides an S0-go logic output through terminal S0 when in the 0 state, an S1-go logic output through terminal S1 when in the 1 state, an S9-go logic output through terminal S9 when in the S9 state, and a $\overline{S9}$-go logic output through terminal $\overline{S9}$ when in the $\overline{S9}$ state.

RANGE AND POLARITY ASSEMBLY
(Diagram 76-0714)

The Range and Polarity Assembly:

1. Selects:
   a. Internal reference voltage polarity
   b. External reference voltage polarity
   c. Front panel indicator polarity
2. Controls correct polarity relationship between the signal input voltage and the error voltage input to the Amplifier Assembly.
3. Counts ranges as directed by up and down pulses.

4. Provides range commands through the front panel RANGE switch DC AUTO position to the Attenuator and Pre-amp Assembly.

5. Provides range logic outputs to the Logic Matrix Assembly.

The POLARITY section of the assembly receives the internal 10 volt reference from the Reference and Ratio Assembly at terminals REF+ and REF-, change polarity commands from the Logic Matrix Assembly at terminal DN-P, and a polarity go or no-go logic input from the front panel FUNCTION switch at terminal POL-DR.

Transistors Q3 and Q4 form a bistable multivibrator. The multivibrator changes state each time a -28 volt change polarity command is applied to terminal DN-P. The polarity-corrected internal reference voltage is provided through terminals POT HI and POT LO back to the Reference and Ratio Assembly. Control of the front panel polarity indicators is accomplished through terminals +N and -N. Polarity commands, at a nominal amplitude of +18 volts, are provided through terminals +AMP and -AMP to the Amplifier Assembly. Terminal -AMP is also connected to the Reference and Ratio Assembly to determine the polarity of the external ratio reference voltage.

When the FUNCTION switch is positioned to AC or KΩ, Q7 is turned on which turns off Q5 and Q6 preventing any indication of polarity on the front panel. In any other position of the FUNCTION switch Q7 is turned off.

Up range commands are received at terminal UP-R from the Logic Driver Assembly.

The RANGE BINARIES section contains a two-binary counter. Up range commands cause the counter to count up from one to two and then to three. When the counter has reached the count of three (1000-volt range), the next up range pulse causes the counter to change to the two state (100-volt range). Additional up range pulses cause the counter to alternate between range two and range three, indicating an overvoltage condition.

Down range pulses are received at terminal DN-R from the Logic Matrix Assembly. Down range pulses cause the range counter to change to range one (10-volt range) from any other range.

When the 10K Decade Assembly is in a zero count, common is applied to terminal 10K "0". When the FUNCTION switch is positioned to AC, MV, or KΩ, common is applied to terminal SET R1. Either of these conditions turns off transistor Q14 setting the range counter to range one.

The range counter operates three driver transistors to provide range commands through terminals 1, 2, and 3 to the RANGE switch. When the RANGE switch is positioned to DC AUTO and the FUNCTION switch is positioned to DC, the range commands control the range of the Attenuator and Pre-amp Assembly and the front panel decimal indicator.

Terminals A, $\overline{A}$, B, and $\overline{B}$ are not used.

The Range and Polarity Assembly provides an S1 logic output through terminal S1 to the Logic Matrix Assembly when in range one, and a $\overline{S1}$ logic output through terminal $\overline{S1}$ when in any other range.

REFERENCE AND RATIO ASSEMBLY
(Diagram 76-0724)

CAUTION

If, for any reason, service on the Reference and Ratio Assembly appears necessary, return the assembly to the factory for correction. Only the coarse and fine adjustments should be handled during routine maintenance. No other change or adjustment to the Reference and Ratio Assembly should be attempted. If this caution is not observed, damage to the Reference and Ratio Assembly may result.

The Reference and Ratio Assembly:

1. Provides a stable internal reference voltage.

2. Selects the polarity of the external ratio reference voltage.

3. Selects either the internal reference voltage or the external reference voltage and applies it to the Potentiometer Assemblies.

The AC power input to the Voltage Reference Standard is received at terminals T1, T2, and T3 from power transformer T1.

The AC power is connected to voltage reference standard module Z1. The output of Z1 is connected through terminals + and - to the Range and Polarity Assembly. The polarity-conscious internal reference voltage is connected back to the Reference and Ratio Assembly through terminals B and COM and through normally closed contacts of relay K2 and terminal A to the Potentiometer Assemblies. Potentiometers R4 and R5 provide coarse and fine reference voltage adjustment.

The external ratio reference voltage is applied across terminals COM, -REF, and +REF. The Range and Polarity Assembly -AMP polarity command is received at terminal -AMP.

The normally closed contacts of K1 connect to +REF. A +18 volt polarity command at -AMP allows Q1 to turn on. K1 is energized and its normally open contacts are connected to -REF.

External reference voltage selection commands are received at terminal RATIO DRIVE.

When the FUNCTION switch is positioned to DC RATIO, K2 is energized. The external reference is connected through the normally open contacts of K2 and terminal A to the Potentiometer Assemblies. If the FUNCTION switch is in any other position, K2 is not energized.

POTENTIOMETER ASSEMBLIES
(Diagrams 76-0719 and 76-0720)

The Potentiometer Assemblies:

1. Provide a constant resistance across the reference voltage.

2. Attenuate the reference voltage and apply it to the chopper on the Attenuator and Pre-amp Assembly.

There are four printed circuit boards in the Potentiometer Assemblies, two A potentiometers and two B potentiometers. The two A potentiometers are similar and the two B potentiometers are identical, therefore only one of each is shown in the diagrams. To differentiate between the two A Potentiometer Assemblies and the two B Potentiometer Assemblies, one set is designated A and B and the other set $\overline{A}$ and $\overline{B}$. Terminals D, C, B, and A of each of the Decade Assemblies are connected to the corresponding 10K-D, C, B, and A through 1-D, C, B, and A terminals of the A and B Potentiometer Assemblies. Similarly, terminals $\overline{D}$, $\overline{B}$, $\overline{C}$, and $\overline{A}$ of each of the Decade Assemblies are connected to the corresponding terminals of the $\overline{A}$ and $\overline{B}$ Potentiometer Assemblies. The commands consist of grounds to common which energize the relays on the Potentiometer Assemblies.

Figure 5-5 is a simplified diagram of the A and B potentiometer circuits. A and B are connected in series, and $\overline{A}$ and $\overline{B}$ are connected in series. Set AB is in series with set $\overline{AB}$ through the HI and LO terminals and externally through the Reference and Ratio Assembly voltage reference standard. The attenuated reference voltage is tapped off at a point between B and $\overline{B}$ (POT ARM). The maximum resistance across AB is 100 kilohms and the maximum resistance across $\overline{AB}$ is 100 kilohms. The circuit is so arranged that when the resistance values of A and B are increasing or decreasing, the resistance values of $\overline{A}$ and $\overline{B}$ are changing in the opposite direction. The total resistance of the Potentiometer Assemblies is maintained at a constant 100 kilohms.

Reference voltage HI from the Reference and Ratio Assembly is connected to potentiometer A at terminal 1. Terminal 1 of $\overline{A}$ is connected to reference voltage LO. Terminals 2 of the A and $\overline{A}$ potentiometers are connected to terminals 1 of the B and $\overline{B}$ potentiometers, respectively. The attenuated reference voltage is applied through terminal 2 of both B potentiometers to the Attenuator and Pre-amp Assembly.

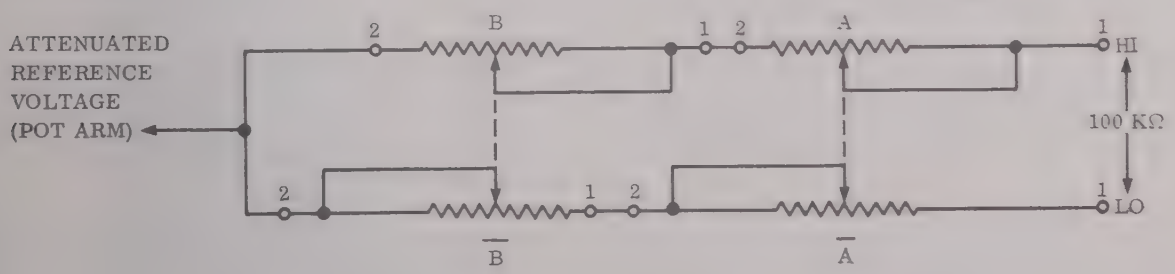


Figure 5-5. Constant-Resistance Potentiometer.

PRINT CONTROL ASSEMBLY - MODEL 7650 ONLY (Diagram 76-0723)

The Print Control Assembly performs the following functions when the front panel PRINT MODE switches are in the following indicated positions:

1. AUTO - Detects a null, places a hold on the instrument, provides a print command (end of conversion), and removes the hold on the instrument.

2. TRACK - Is disabled, allowing the instrument to track continuously.

3. MANUAL - Provides a print command when the MANUAL switch is closed.

Up drive and down drive pulses are received at terminals UP DR and DN DR, respectively, from the Logic Driver Assembly. The drive pulses have an amplitude of approximately -28 volts.

When the PRINT MODE switch is in the AUTO position, the up and down drive pulses turn off Q1, which turns on Q2, shorting capacitor C1 to common. When the drive pulses stop (instrument at null) C1 charges to the trigger level of unijunction transistor Q3. Potentiometer R8, identified on the top shield as PRINT DELAY, determines the charge time of C1. The unijunction triggers, changing the state of the bistable multivibrator Q4 and Q5. Transistors Q6 and Q7 turn off and Q8 turns on, thereby grounding the Logic Driver Assembly gate, disabling the logic driver circuits, and placing a hold on the instrument. Capacitor C4, discharging through K2 and Q5, energizes K2 providing a print command contact closure across terminals PRINT CMD connected to Print Output A Assembly. When C3 charges to the threshold level of CR12, it turns on Q7. Q7 turns off Q8, releasing the hold on the Logic Driver Assembly gate. The bistable multivibrator is reset by more up and down drive pulses. This ensures only one print command per null.

When the PRINT MODE switch is positioned to TRACK, terminal HOLD is grounded, the Print Control Assembly is disabled, and the Logic Driver Assembly gate is disconnected from the Print Control Assembly.

The MANUAL switch, when closed while the instrument is in the AUTO or TRACK print modes, energizes relay K1 and grounds the Logic Driver Assembly gate. The contacts of K1 close and issue a print command regardless of the instrument null condition.

When the PRINT MODE switch is positioned to HOLD, the switch contacts ground the Logic Driver gate and disconnect the Print Control Assembly PRINT CMD terminal from the Print Output A Assembly.

PRINT OUTPUT ASSEMBLIES — MODEL 7650 ONLY (Diagrams 76-0708, 76-0709, 76-0710, and 76-0707)

The Print Output Assemblies provide isolated print output contact closures in a 10-line decimal code through rear panel connectors J2, J3, and J4. BCD print output is available upon request. The Print Output Assemblies consist of four printed circuit boards, Print Output A is shown in diagram 76-0708, Print Output B is shown in diagram 76-0709, Print Output C is shown in diagram 76-0710, and Print Output D is shown in diagram 76-0707. The data relayed to the printer includes the front panel indication, decimal point location, function, polarity, and print (end of conversion) command.

Print Output A receives printout commands through terminals 0 through 9 from the Units Decade Assembly, through terminals D1 through D5 from the RANGE switch, and through terminals - and + from the Range and Polarity Assembly. The print command is received at the PRINT COMD terminals from the Print Control Assembly.

Print Output B receives printout commands through terminals 10's 0 through 9 from the Tens Decade Assembly, through terminals 100's 0 through 9 from the Hundreds Decade Assembly, and through terminals 1K's 0 through 9 and 1K PRINT COM from Print Output C.

Print Output C receives printout commands through terminals 0 through 9 from the Thousands Decade Assembly. Terminals 1K PRINT COM and 9 through 0 are connected through Print Output Assembly B to the print output connector.

Print Output D receives printout commands through terminals 0 through 9 from the Ten Thousands Decade Assembly and through terminals DCR, KΩ, MV, AC, and DC from the FUNCTION switch.

POWER SUPPLIES 1 AND 2 (Diagram 76-0721)

These two assemblies furnish supply voltages for the instrument. The voltages are +230 volts, +35 volts, +25 volts, +23 volts, +14 volts, +1 volt, and -36 volts. The +230-volt, +35-volt, +23-volt, and -36-volt supplies are full wave bridge rectified, filtered and unregulated. The +25-volt, +14-volt, and +1-volt supplies are full wave rectified, filtered and regulated. Regulation is accomplished by circuits which are nearly identical except for component values, therefore only the +14-volt regulator will be described.

Regulation is accomplished by passing transistor Q3, which is mounted on the chassis for efficient heat sink operation. The regulated output is compared against the voltage across CR15, amplified by Q1, and connected to the base of Q3. Diodes CR13 and CR14 provide overload protection for passing transistor Q3. Similarly, diodes CR16 and CR17 provide overload protection for Q1. Current for the zener regulator CR15 is obtained from the regulated +25-volt supply through terminal +25.

AC power is received through terminals T5 through T12 from the secondary windings of the power transformer.

SECTION VI

MAINTENANCE

GENERAL MAINTENANCE INFORMATION

Each assembly is inserted into an associated slot on the chassis. The assembly and the associated slot have corresponding numbers. The number appears on the rail adjacent to the slot and on the assembly. As an aid in mating an assembly with the slot, the number on the rail is matched with the number on the assembly.

Standard electronic parts used in the instrument may be obtained locally. It is recommended, however, that precision components and mechanical parts be ordered from a Cimron representative or direct from the factory.

CAUTION

When replacing components on an assembly, care should be taken to prevent damage to the board from excessive heat. A low wattage soldering iron is recommended for soldering operations on the assembly. Whenever practicable, a heat sink should be used between the soldering point and the transistor body.

TROUBLESHOOTING

Troubleshooting the instrument is extremely simple. Since the majority of components in the instrument are mounted on plug-in circuit board assemblies, troubleshooting is reduced to systematically replacing existing assemblies with spare assemblies until the defect is remedied. Down time is reduced to a very few minutes.

When no spare assemblies are available, troubleshooting is accomplished by checking the optimum voltage values listed on all applicable schematic diagrams. Failure to obtain the required voltage value at an indicated point indicates which assembly is defective.

Faulty assemblies can be repaired or returned to Cimron or a Cimron representative for repair. Replacement of the Attenuator and Pre-amp Assembly, Amplifier Assembly, Logic Driver Assembly, or Reference and Ratio Assembly requires complete recalibration of the instrument.

SEMICONDUCTOR PARAMETERS

CD-61, I_f = 1V greater than 100 ma,
I_r = 75V less than 1 ua, SILICON

CD-62, I_f = 1V greater than 100 ma,
I_r = 250V less than 6 ua, SILICON

CD-63, I_f = 1V greater than 15 ma,
I_r = 30V less than 100 ua, GERMANIUM

PARTS LIST

CIMRON ASSEMBLY: Attenuator and Preamplifier — CIMRON PART NO. 76-6016

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
CAPACITOR						
C1601, C1602	5.14 nf	POLY	200V 1%	12406	PD2A5141F	1-57346
C1603	0.01 μf	POLY	200V 1%	12406	PD2A103F	1-57338
C1604, C1605	0.1 μf	MET PAP	50V 10%	12406	VX5A104K	1-57321
C1606	15 nf	POLY	200V 20%	12406	PD2362	1-57310
C1607 - C1609	2.2 nf	GLASS	500V 10%	07115	CYFM20C222K	1-57601
C1610	560 pf	GLASS	500V 10%	07115	CYFM20C561K	1-57600
C1611	15 nf	POLY	200V 20%	12406	PD2362	1-57310
C1612	22 pf	SIL MICA	500V 5%	04062	CM-15-C-220J	1-57463
C1613	1 μf	MET PAP	50V 10%	12406	VX5A105K	1-57317
C1614	100 μf	ELECT	25V	14655	NLW 100-25	1-57253
C1615	1 μf	MET PAP	50V 10%	12406	VX5A105K	1-57317
C1616	0.1 μf	POLY	200V 20%	12406	PD2363	1-57309
C1617	0.47 μf	MET PAP	50V 10%	12406	VX5A474K	1-57318
C1618	560 pf	CER DISC		71590	DD-561	1-57500
RESISTOR						
R1601*	10 MΩ	MET FILM	2W 0.25%	07716	MEH-T9	7-46121
R1602	560 KΩ	COMP	2W 5%	01121	HB-5645	7-45076
R1603*	100.75 KΩ	COMP WW	0.05%	07088	OB	7-47200
R1604	500Ω	VAR TRIM WW		97704	1PC-500Ω	7-54240
R1605*	1 MΩ	MET FILM	1/2W 0.25%	07716	MEC-T9	7-46120
R1606*	105 KΩ	MET FILM	1/2W 0.25%	07716	MEC-T9	7-46135
R1607	10 KΩ	VAR TRIM WW		97704	1PC-500Ω	7-54242
R1608	523 KΩ	DEP CARB	1/8W 1%	07716	RN-60B	7-46522
R1609	255 KΩ	MET FILM	1/8W 1%	07716	MEA	7-46139
R1610	523 KΩ	DEP CARB	1/8W 1%	07716	RN-60B	7-46522
R1611 - R1612	100 KΩ	COMP	1/2W 5%	01121	EB-1045	7-41067
R1613	3.32 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46504
R1614	100 KΩ	COMP	1/2W 5%	01121	EB-1045	7-41067
R1615	47 KΩ	COMP	1/2W 5%	01121	EB-4735	7-41063
R1616	475 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46505
R1617	5.6 KΩ	COMP	1/2W 5%	01121	CB-5625	7-41052
R1618	2.74 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46503
R1619	3.32 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46504
R1620	1 KΩ	COMP	1/2W 5%	01121	EB-1025	7-41043
R1621	47 KΩ	COMP	1/2W 5%	01121	EB-4735	7-41063
R1622	1 KΩ	COMP	1/2W 5%	01121	EB-1025	7-41043
R1623	2.2 KΩ	COMP	1/2W 5%	01121	EB-2225	7-41047
Resistor Kit*						5-40021*
SEMICONDUCTOR						
CR1601		CD-61 DIODE		15318		7-95511
CR1602		CD-62 DIODE		15318		7-95507
CR1603		CD-61 DIODE		15318		7-95511

PARTS LIST

CIMRON ASSEMBLY: Attenuator and Preamplifier — CIMRON PART NO. 76-6016

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
SEMICONDUCTOR (Cont'd)						
CR1604		CD-62 DIODE		15318		7-95507
CR1605		CD-61 DIODE		15318		7-95511
CR1606		CD-62 DIODE		15318		7-95507
CR1607		CD-61 DIODE		15318		7-95511
CR1608, CR1609		DIODE		72314	FD-300	7-95505
CR1610, CR1611		CD-61 DIODE		15318		7-95511
CR1612, CR1613		ZENER DIODE		JEDEC	1N712	7-95611
TRANSISTOR						
Q1601, Q1602		CT-26 or 2N2222		15318		9-04710
Q1603				JEDEC	2N3567	9-04719
MISCELLANEOUS						
T1601		TRANSFORMER		84171	TT-039	9-01003
G1601		CHOPPER		15318		70-0505-1
L1601 - L1604		REED COIL		15318		70-0501-1
S1601		RELAY REED SPST		12617	DRG-1	7-38208
S1602 - S1604		RELAY REED SPST		12617	DRG-5	7-38211
VR1601, VR1602		NEON LAMP		15318	NE-68	5-46503
		CHOPPER BKT		15318		70-2005-1
		CHOPPER SOCKET - 4 PIN		72825	9721-194	8-24110
		SHIELD ASSEMBLY		15318		70-2004-1
		ETCHED CIRCUIT BOARD		15318		76-7016

*Either R1601, R1603, R1605, and R1606 or a resistor kit may be used.

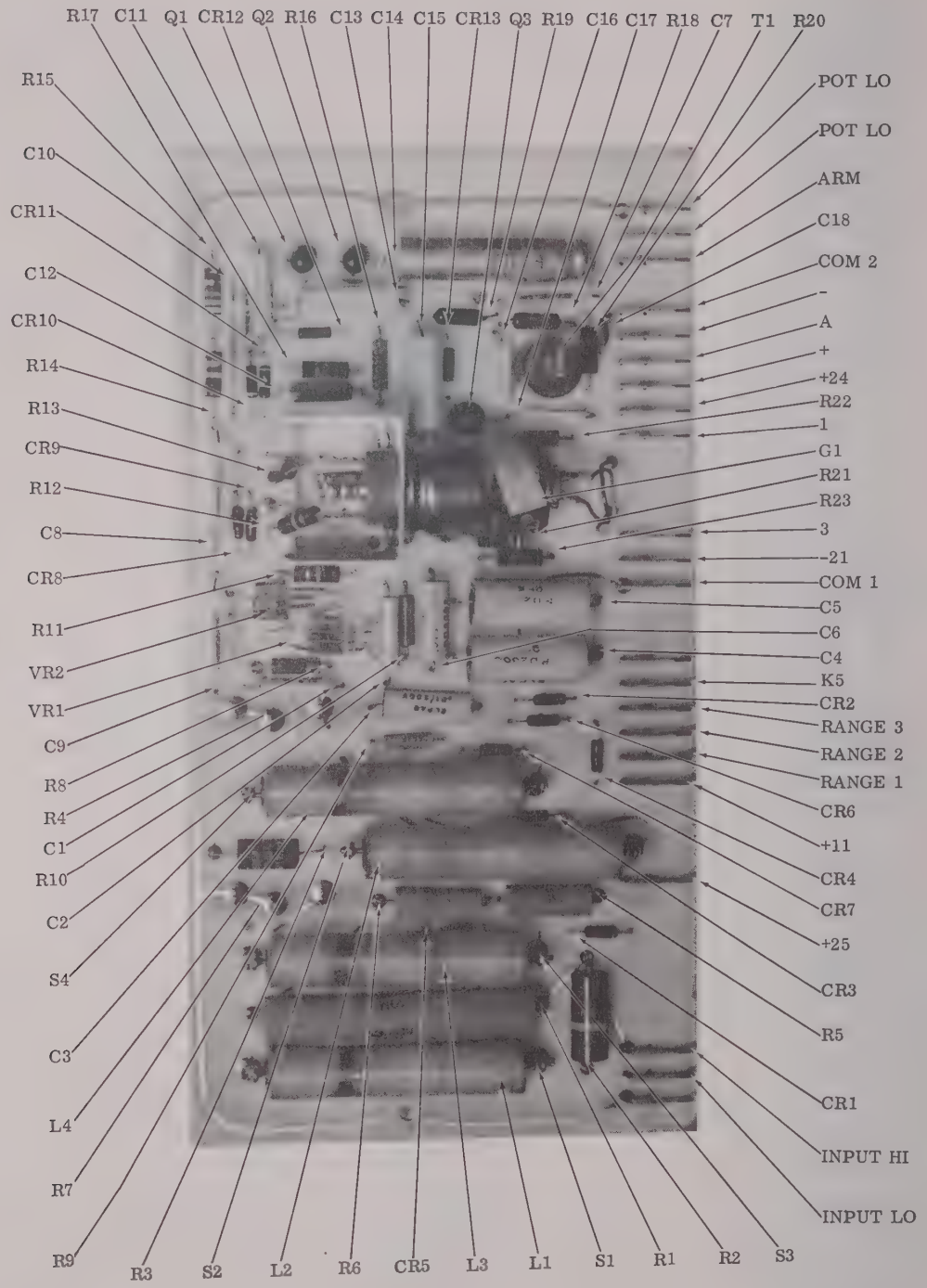
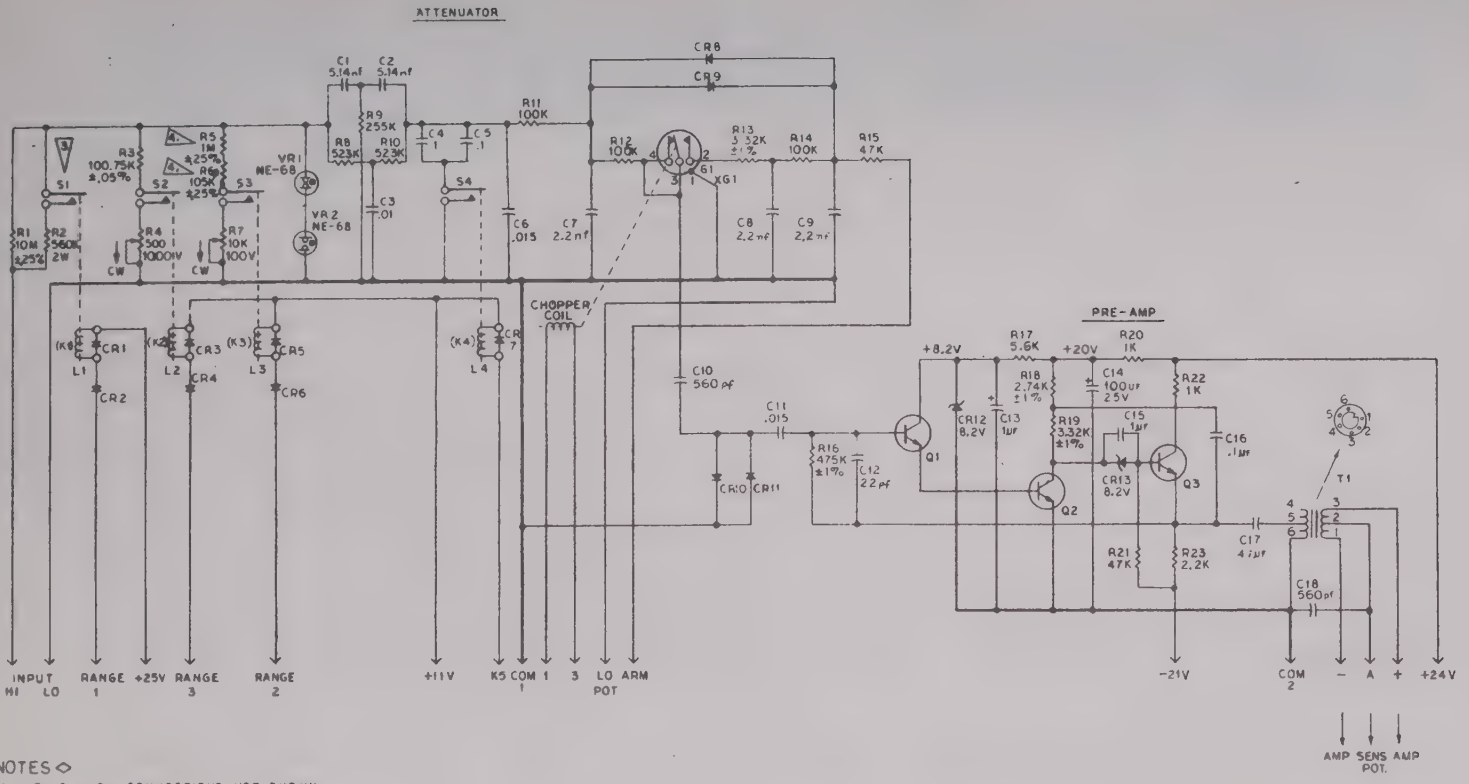


Figure 6-1. Attenuator and Pre-amp Assembly.



NOTES ◇

1. PLUG-IN PIN CONNECTIONS NOT SHOWN IN SAME ORDER AS ON ASSEMBLY.
2. UNLESS OTHERWISE NOTED, RESISTORS ARE ½ WATT & ± 5% TOLERANCE.
3. PARTIAL REFERENCE DESIGNATIONS SHOWN. ALL NUMBERS ARE IN SERIES 1601 AND ON. FOR COMPLETE DESIGNATION ADD 1600 TO DIGITS SHOWN. EXAMPLE. S1 IS S1601.
4. R5 & R6 CAN BE A 1.105M Ω A JUMPER.

76-0716
REL DATE 8-1-W A
ECN 1640 REV "A"

DRAWING SIZE D	SCHEMATIC — 76-6016 ATTENUATOR & PRE-AMP ASSY					CIMRON	
	DESIGN					76-0716	REV A
7600 SERIES	CHECK			CHT ENG			
MODEL	DRAFT	W.J.B.	8/31	PROJECT			
		APPD	DATE		APPD	DATE	SCALE NONE SHEET 1 OF 1

PARTS LIST

CIMRON ASSEMBLY: Amplifier — CIMRON PART NO. 76-6013

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
CAPACITOR						
C1302	0.47 μf	MET PAP	50V 10%	12406	VX5A474K	1-57318
C1303	1.8 nf	CER DISC	10%	71590	DD-182	1-57503
C1304	0.1 μf	MET PAP	50V 10%	12406	VX5A104K	1-57321
C1305	22 nf	MET PAP	50V 10%	12406	VX5A223K	1-57326
C1306	0.1 μf	MET PAP	50V 10%	12406	VX5A104K	1-57321
C1307	22 pf	SILVER MICA	5%	04062	CM-15-C-220J	1-57463
C1308	22 nf	MET PAP	50V 10%	12406	VX5A223K	1-57326
C1309	0.47 μf	MET PAP	50V 10%	12406	VX5A474K	1-57318
C1310	20 μf	ELECT	50V	14655	NLW 20-50	1-57256
C1311	0.22 μf	MET PAP	50V 10%	12406	VX5A224K	1-57319
C1312	22 nf	MET MY	200V 20%	14752	215BIC23M2	1-57356
C1315	1 μf	MET PAP	50V 10%	12406	VX5A105K	1-57317
C1316	0.22 μf	MET PAP	50V 10%	12406	VX5A224K	1-57319
C1317 - C1319	1.8 nf	CER DISC	10%	71590	DD-182	1-57503
C1320	1 μf	MET PAP	50V 10%	12406	VX5A105K	1-57317
C1321	22 μf	TANT	35V 20%	01295	SCM226GP035D4	1-57102
RESISTOR						
R1301	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1302	56 KΩ	COMP	1/2W 5%	01121	EB-5635	7-41064
R1303	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1304	56 KΩ	COMP	1/2W 5%	01121	EB-5635	7-41064
R1308, R1309	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055
R1310	4.7 KΩ	COMP	1/2W 5%	01121	EB-4725	7-41051
R1311	10 KΩ	VAR TRIM WW	10%	80294	275-1-103	7-54103
R1312	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1313	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055
R1314	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1315	4.75 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46500
R1316 - R1318	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1319	5.6 KΩ	COMP	1/2W 5%	01121	EB-5625	7-41052
R1320	33 KΩ	COMP	1/2W 5%	01121	EB-3335	7-41061
R1321	47.5 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46502
R1322	3.3 KΩ	COMP	1/2W 5%	01121	EB-3325	7-41049
R1323	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1324	6.8 KΩ	COMP	1/2W 5%	01121	EB-6825	7-41053
R1325 - R1327	33 KΩ	COMP	1/2W 5%	01121	EB-3335	7-41061
R1328	68 KΩ	COMP	1/2W 5%	01121	EB-6835	7-41065
R1329	680Ω	COMP	1/2W 5%	01121	EB-6815	7-41041
R1330	2.2 KΩ	COMP	1/2W 5%	01121	EB-2225	7-41047
R1331	68 KΩ	COMP	1/2W 5%	01121	EB-6835	7-41065
R1332	1 KΩ	COMP	1/2W 5%	01121	EB-1025	7-41043
R1333	68 KΩ	COMP	1/2W 5%	01121	EB-6835	7-41065
R1334	470Ω	COMP	1/2W 5%	01121	EB-4715	7-41039
R1335	220Ω	COMP	1/2W 5%	01121	EB-2215	7-41035

PARTS LIST

CIMRON ASSEMBLY: Amplifier — CIMRON PART NO. 76-6013

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
RESISTOR (Cont'd)						
R1336, R1337	10 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46501
R1338	56Ω	COMP	1/2W 5%	01121	EB-5605	7-41028
R1339	2 KΩ	VAR TRIM WW	10%	80294	275-1-202	7-54202
R1340	15 KΩ	COMP	1/2W 5%	01121	EB-1535	7-41057
R1341	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1342	47.5 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46502
R1345	5.6 KΩ	COMP	1/2W 5%	01121	EB-5625	7-41052
R1346, R1347	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1348, R1349	680Ω	COMP	1/2W 5%	01121	EB-6815	7-41041
R1350	3.3 KΩ	COMP	1/2W 5%	01121	EB-3325	7-41049
R1351, R1352	4.7 KΩ	COMP	1/2W 5%	01121	EB-4725	7-41051
R1353, R1354	100 KΩ	COMP	1/2W 5%	01121	EB-1045	7-41067
R1355	120Ω	COMP	1/2W 5%	01121	EB-1215	7-41032
R1356	15 KΩ	COMP	1/2W 5%	01121	EB-1535	7-41057
RT1301	20 KΩ	THERM	25°C	79094	1D051	7-48502
SEMICONDUCTOR						
CR1301 - CR1308		CD-62 SIL TYPE DIODE		15318		7-95507
CR1314				JEDEC	1N750	7-95608
CR1315				JEDEC	1N722	7-95612
TRANSISTOR						
Q1301, Q1302				JEDEC	2N1304	9-04500
Q1304		CT-20 or 2N697		15318		9-04701
Q1305, Q1306		CT-26 or 2N2222		15318		9-04710
Q1307		CT-20 or 2N697		15318		9-04701
Q1308 - Q1310				JEDEC	2N404A	9-04609
Q1311 - Q1313		CT-20 or 2N697		15318		9-04701
Q1314				JEDEC	2N1183B	9-04605
Q1315, Q1316				JEDEC	2N1304	9-04500
MISCELLANEOUS						
T1301		TRANSFORMER PRINTED CIRCUIT		84171	TT-039	9-01003
		ETCHED CIRCUIT BOARD		15318		76-7013-5
		SHIELD ASSEMBLY		15318		76-2006-1

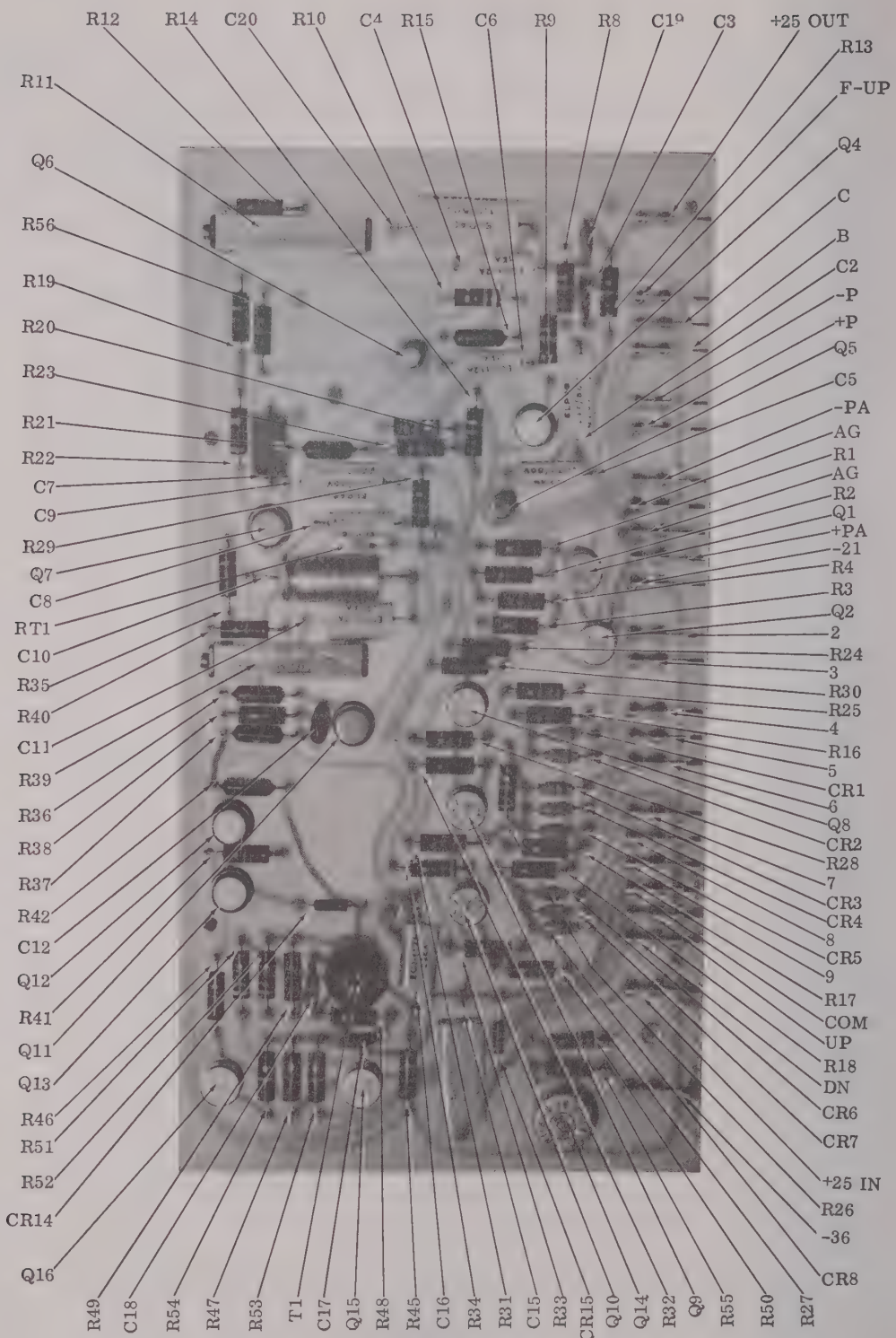
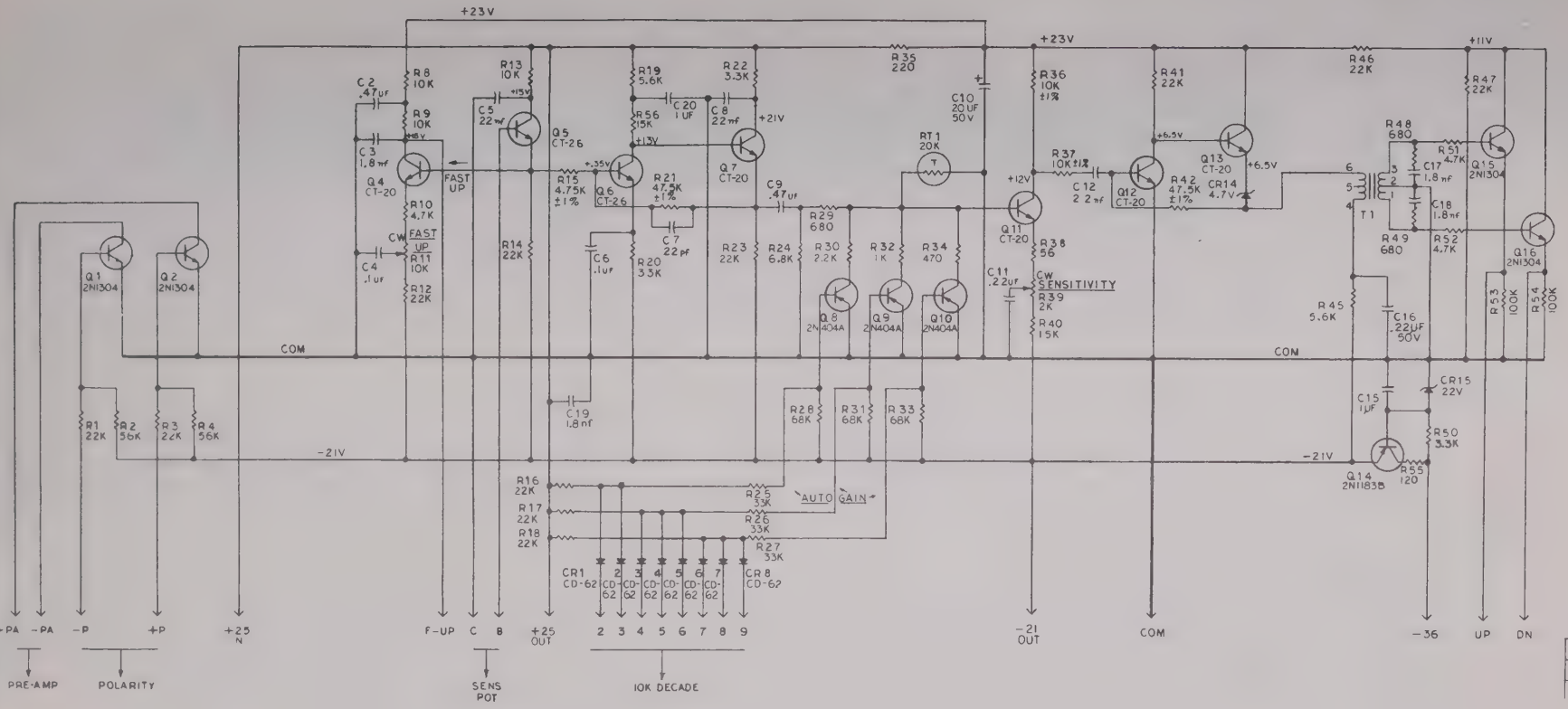


Figure 6-2. Amplifier Assembly.



6-9

NOTES ◇

1. PLUG-IN PIN CONNECTIONS NOT SHOWN IN SAME ORDER AS ON ASSEMBLY.
2. UNLESS OTHERWISE NOTED, RESISTORS ARE ½ WATT & ± 5% TOLERANCE.
3. PARTIAL REFFRENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR ADD 1300. EXAMPLE R1 IS R1301.

76-0713
REL DATE 7/1/00 A
A-ECN 1642

SIZE D	SCHEMATIC — 76-6013 AMPLIFIER ASSY						CIMRON	
	DESIGN						76-0713	REV A
7000 SERIES	DRAFT	WJB		PROJECT				
MODEL		APPD	DATE		APPD	DATE	SCALE NONE	SHEET 1 OF 1

PARTS LIST

CIMRON ASSEMBLY: Logic Driver — CIMRON PART NO. 76-6012

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
CAPACITOR						
C1201	0.1 μf	PAP	50V	12406	VX5A104K	1-57321
C1202	22 nf	PAP	50V	12406	VX5A223K	1-57326
C1203	2.2 μf	TANT	35V	01295	SCM225BP035D4	1-57104
C1204	560 pf	CER DISC	1000V	71590	DD-561	1-57500
C1205	50 μf	ELECT	50V	14655	NLW 50-50	1-57257
C1206	1 nf	CER DISC	1000V	71590	DD-102	1-57504
C1207	4.7 nf	PAP	50V	12406	VX5A472K	1-57331
C1208	22 nf	PAP	50V	12406	VX5A223K	1-57326
C1209	50 μf	ELECT	50V	14655	NLW 50-50	1-57257
C1210	0.22 μf	PAP	50V	12406	VX5A224K	1-57319
C1211 - C1213	560 pf	CER DISC	1000V	71590	DD-561	1-57500
C1214, C1215	1 μf	PAP	50V	12406	VX5A105K	1-57317
C1216	1.8 nf	CER DISC	1000V	71590	DD-182	1-57503
C1217	1 nf	CER DISC	1000V	71590	DD-102	1-57504
C1218	4.7 nf	PAP	50V	12406	VX5A472K	1-57331
C1219, C1220	22 nf	PAP	50V	12406	VX5A223K	1-57326
C1221	50 μf	ELECT	50V	14655	NLW 50-50	1-57257
C1222	0.01 μf	PAP	50V	12406	VX5A103K	1-57323
C1223	4.7 nf	PAP	50V	12406	VX5A472K	1-57331
C1224	22 nf	PAP	50V	12406	VX5A223K	1-57326
C1225	0.01 μf	PAP	50V	12406	VX5A103K	1-57323
C1226	15 nf	MET PAP	50V	12406	VX5A153K	1-57329
RESISTOR						
R1201, R1202	12 KΩ	COMP	1/2W 5%	01121	EB-1235	7-41056
R1203	33 KΩ	COMP	1/2W 5%	01121	EB-3335	7-41061
R1204	12 KΩ	COMP	1/2W 5%	01121	EB-1235	7-41056
R1205	56 KΩ	COMP	1/2W 5%	01121	EB-5635	7-41064
R1206	68 KΩ	COMP	1/2W 5%	01121	EB-6835	7-41065
R1207, R1208	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055
R1209	12 KΩ	COMP	1/2W 5%	01121	EB-1235	7-41056
R1210, R1211	3.3 KΩ	COMP	1/2W 5%	01121	EB-3325	7-41049
R1212, R1213	15 KΩ	COMP	1/2W 5%	01121	EB-1535	7-41057
R1214, R1216	100 KΩ	COMP	1/2W 5%	01121	EB-1045	7-41067
R1217, R1218	180 KΩ	COMP	1/2W 5%	01121	EB-1845	7-41070
R1219	100 KΩ	COMP	1/2W 5%	01121	EB-1045	7-41067
R1220	330Ω	COMP	1/2W 5%	01121	EB-3315	7-41037
R1221	2.2 KΩ	COMP	1/2W 5%	01121	EB-2225	7-41047
R1222	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1223	2.2 KΩ	COMP	1/2W 5%	01121	EB-2225	7-41047
R1224, R1225	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1226	100Ω	DEP CARB	1/8W 1%	00656	TYPE CPM	7-46507
R1227	3.3 KΩ	COMP	1/2W 5%	01121	EB-3325	7-41049
R1228	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055

PARTS LIST

CIMRON ASSEMBLY: Logic Driver — CIMRON PART NO. 76-6012

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
RESISTOR (Cont'd)						
R1229, R1230	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1231	100Ω	DEP CARB	1/8W 1%	00656	TYPE CPM	7-46507
R1232	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1233	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071
R1234	3.3 KΩ	COMP	1/2W 5%	01121	EB-3325	7-41049
R1235	6.8 KΩ	COMP	1/2W 5%	01121	EB-6825	7-41053
R1236	470Ω	COMP	1/2W 5%	01121	EB-4715	7-41039
R1237	20 KΩ	WW	1/4W	80294	200P-1-203	7-54203
R1239	47Ω	COMP	1/2W 5%	01121	EB-4705	7-41027
R1240	47 KΩ	COMP	1/2W 5%	01121	EB-4735	7-41063
R1241	150 KΩ	COMP	1/2W 5%	01121	EB-1545	7-41069
R1242	1 MΩ	COMP	1/2W 5%	01121	EB-1055	7-41079
R1243, R1244	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055
R1245	100 KΩ	COMP	1/2W 5%	01121	EB-1045	7-41067
R1246	680 KΩ	COMP	1/2W 5%	01121	EB-6845	7-41077
R1247, R1248	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1249	220Ω	COMP	1/2W 5%	01121	EB-2215	7-41035
R1250	180Ω	COMP	1/2W 5%	01121	EB-1815	7-41034
R1251, R1252	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071
R1253	4.7 KΩ	COMP	1/2W 5%	01121	EB-4725	7-41051
R1254	2.2 KΩ	COMP	1/2W 5%	01121	EB-2225	7-41047
R1255	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1256	2.2 KΩ	COMP	1/2W 5%	01121	EB-2225	7-41047
R1257, R1258	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1259	200Ω	TRIMPOT WW		80294	275-1-201	7-54215
R1260	3.3 KΩ	COMP	1/2W 5%	01121	EB-3325	7-41049
R1261	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055
R1262	47Ω	COMP	1/2W 5%	01121	EB-4705	7-41027
R1263, R1264	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1265	100Ω	DEP CARB	1/8W 1%	00656	TYPE CPM	7-46507
R1266	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1267	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071
R1268	3.3 KΩ	COMP	1/2W 5%	01121	EB-3325	7-41049
R1269	5.6 KΩ	COMP	1/2W 5%	01121	EB-5625	7-41052
R1270	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1271	5.6 KΩ	COMP	1/2W 5%	01121	EB-5625	7-41052
R1272	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1273	6.8 KΩ	COMP	1/2W 5%	01121	EB-6825	7-41053
R1274	5.6 KΩ	COMP	1/2W 5%	01121	EB-5625	7-41052
R1275	2.2 KΩ	COMP	1/2W 5%	01121	EB-2225	7-41047
R1276	270Ω	COMP	1/2W 5%	01121	EB-2715	7-41036
R1277	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055
R1278, R1279	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1280	1.5 KΩ	COMP	1/2W 5%	01121	EB-1525	7-41045
R1281	47Ω	COMP	1/2W 5%	01121	EB-4705	7-41027

PARTS LIST

CIMRON ASSEMBLY: Logic Driver — CIMRON PART NO. 76-6012

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
RESISTOR (Cont'd)						
R1282	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1283	100Ω	DEP CARB	1/8W 1%	00656	TYPE CPM	7-46507
R1284	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1285	180 KΩ	COMP	1/2W 5%	01121	EB-1845	7-41070
R1286	3.3 KΩ	COMP	1/2W 5%	01121	EB-3325	7-41049
R1287	68 KΩ	COMP	1/2W 5%	01121	EB-6835	7-41065
SEMICONDUCTOR						
CR1201 - CR1210		CD-61 DIODE		15318		7-95511
CR1211		ZENER DIODE		JEDEC	1N973B	7-95616
CR1212 - CR1220		CD-61 DIODE		15318		7-95511
TRANSISTOR						
Q1201 - Q1210				JEDEC	2N3567	9-04719
Q1211		UNIJUNCTION		JEDEC	2N2647 or 4JD5E29 or 4JDX5E738	9-04400
Q1212 - Q1221				JEDEC	2N3567	9-04719
MISCELLANEOUS						
L1201		REED COIL		15318		70-0511-1
S1201		REED SWITCH		95348	MR-306-8	7-38216
RT1201	100 KΩ	RESISTOR, THERM ROD	25°C	79094	51R5	7-48500
		ETCHED CIRCUIT BOARD		15318		76-7012-5

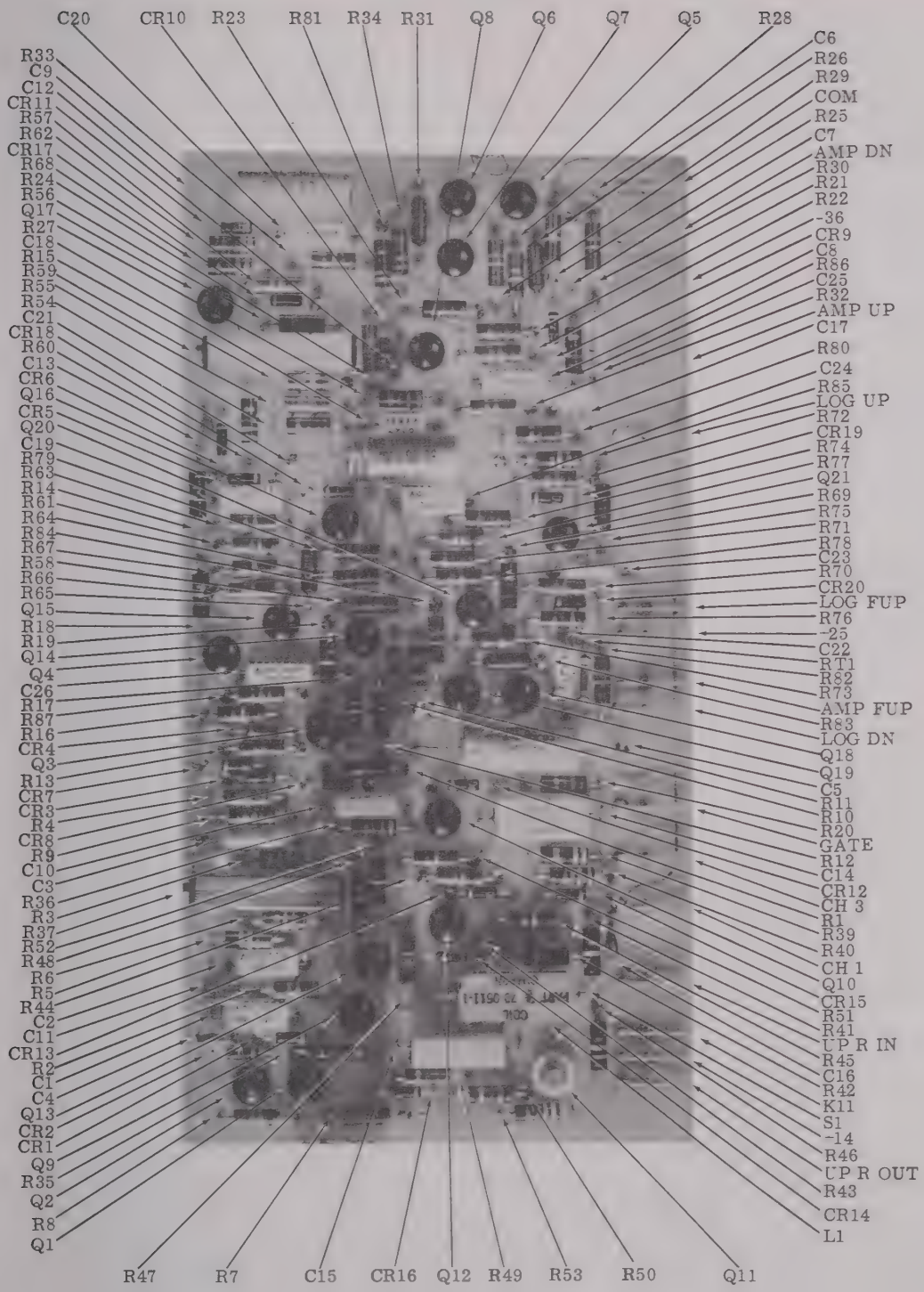
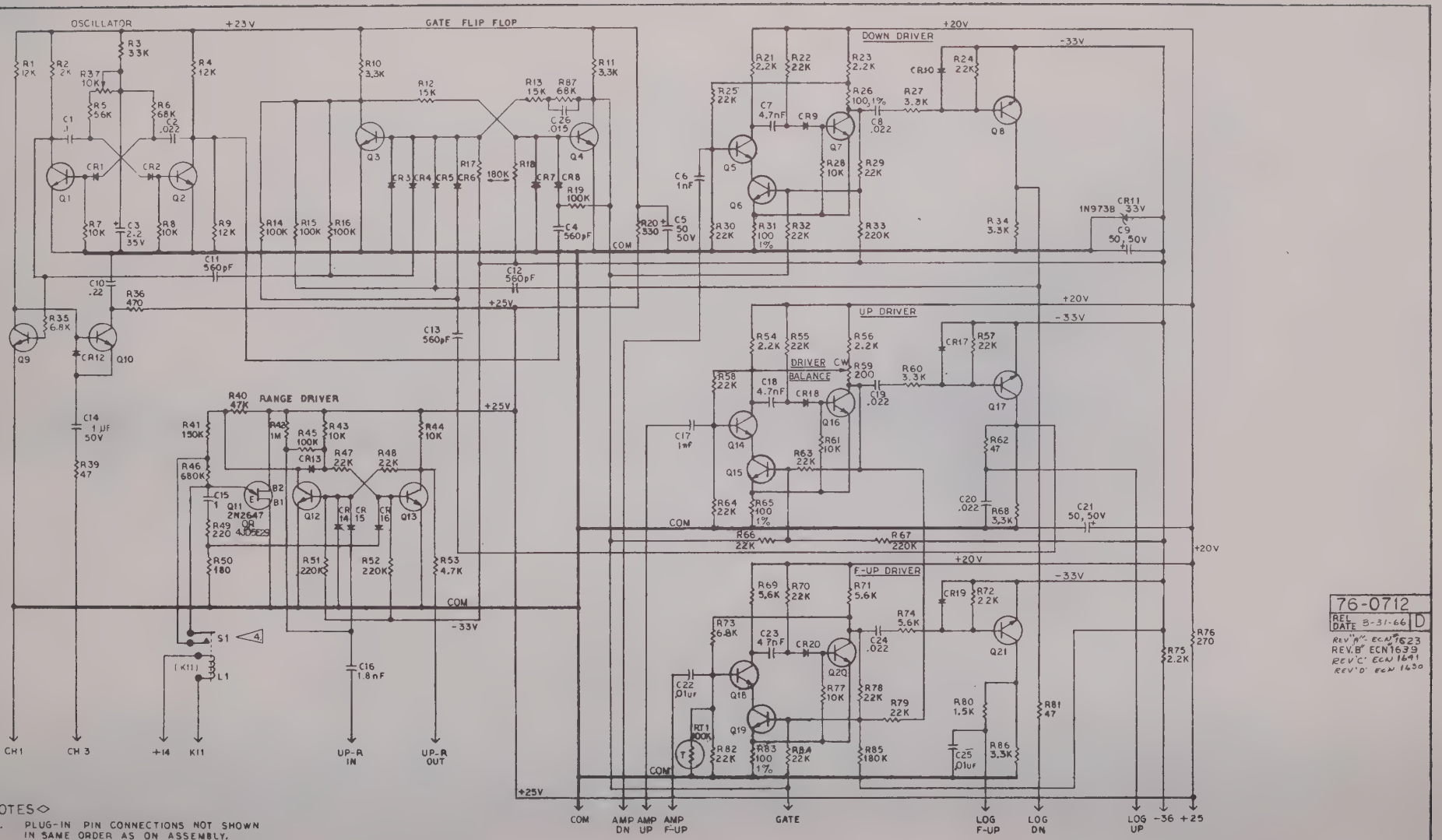


Figure 6-3. Logic Driver Assembly.



NOTES◇

1. PLUG-IN PIN CONNECTIONS NOT SHOWN IN SAME ORDER AS ON ASSEMBLY.
2. UNLESS OTHERWISE NOTED, RESISTORS ARE 1/2 WATT & ±5% TOLERANCE.
3. SELECTED VALUE.
4. PARTIAL REFERENCE DESIGNATIONS SHOWN. ALL NUMBERS ARE IN SERIES 1201 AND ON. FOR COMPLETE DESIGNATION ADD 1200 TO DIGITS SHOWN. EXAMPLE: S1 IS S1201.
5. ALL TRANSISTORS ARE 2N3567 EXCEPT FOR Q11.
6. ALL DIODES ARE CD61 EXCEPT FOR CR14

DRAWING SIZE D	SCHEMATIC — LOGIC DRIVER ASSY 75-6012						CIMRON
	DESIGN						
7600 Series	CHECK						76-0712 D
	QUALITY	WJB					

76-0712 REL DATE 8-31-66 D

REV'A' ECN 1623
REV.B' ECN 1639
REV'C' ECN 1691
REV'D' ECN 1830

PARTS LIST

CIMRON ASSEMBLY: Logic Matrix — CIMRON PART NO. 76-6017

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R1701 - R1706	2.2 KΩ	COMP	1/4W 5%	01121	CB-2225	7-41247
R1707 - R1711	4.7 KΩ	COMP	1/4W 5%	01121	CB-4725	7-41251
R1712 - R1721	2.7 KΩ	COMP	1/4W 5%	01121	CB-2725	7-41248
R1722 - R1729	2.2 KΩ	COMP	1/4W 5%	01121	CB-2225	7-41247
SEMICONDUCTOR						
CR1701 - CR1773		CD-61 DIODE		15318		7-95511
MISCELLANEOUS						
		ETCHED CIRCUIT BOARD		15318		76-7017-1

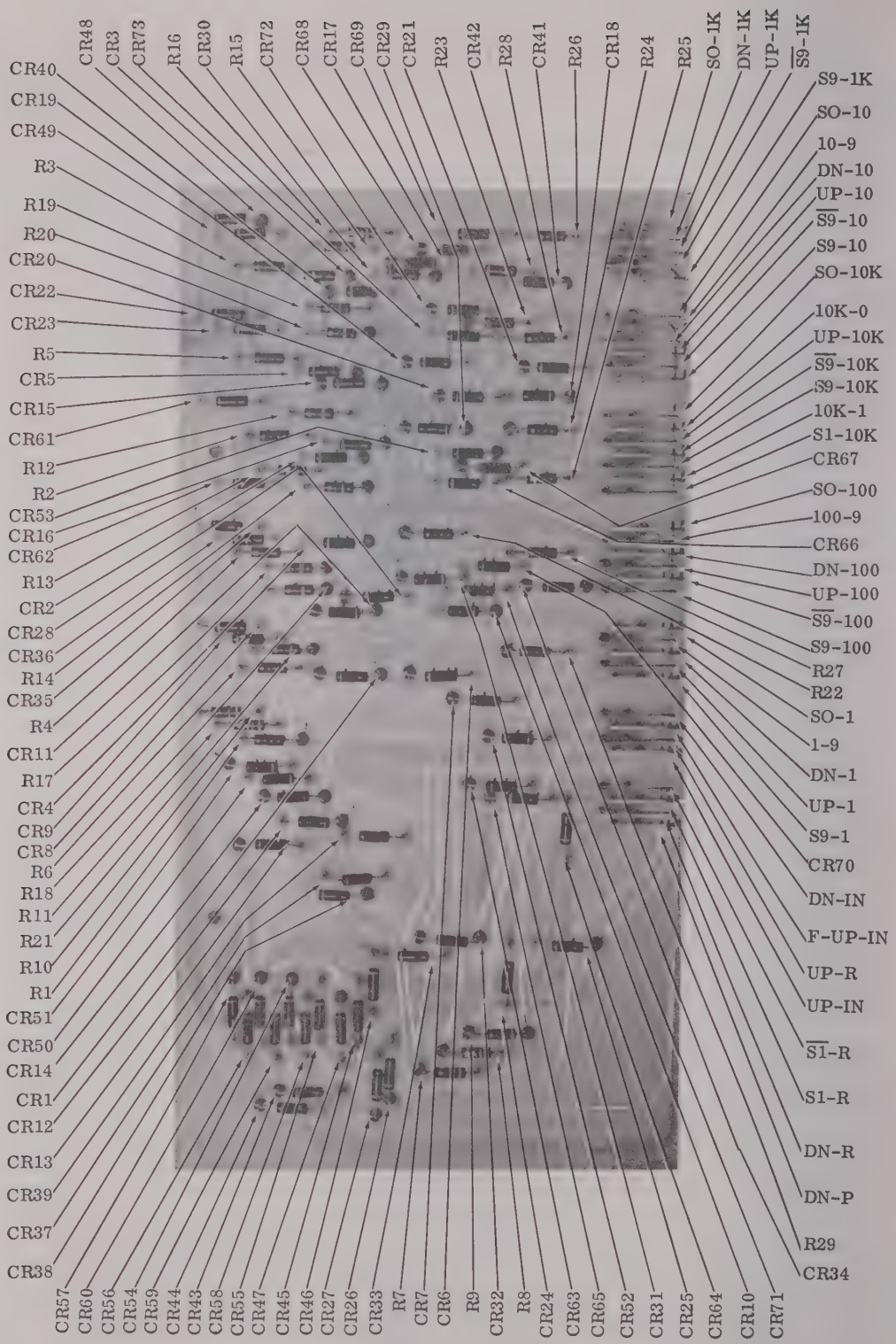
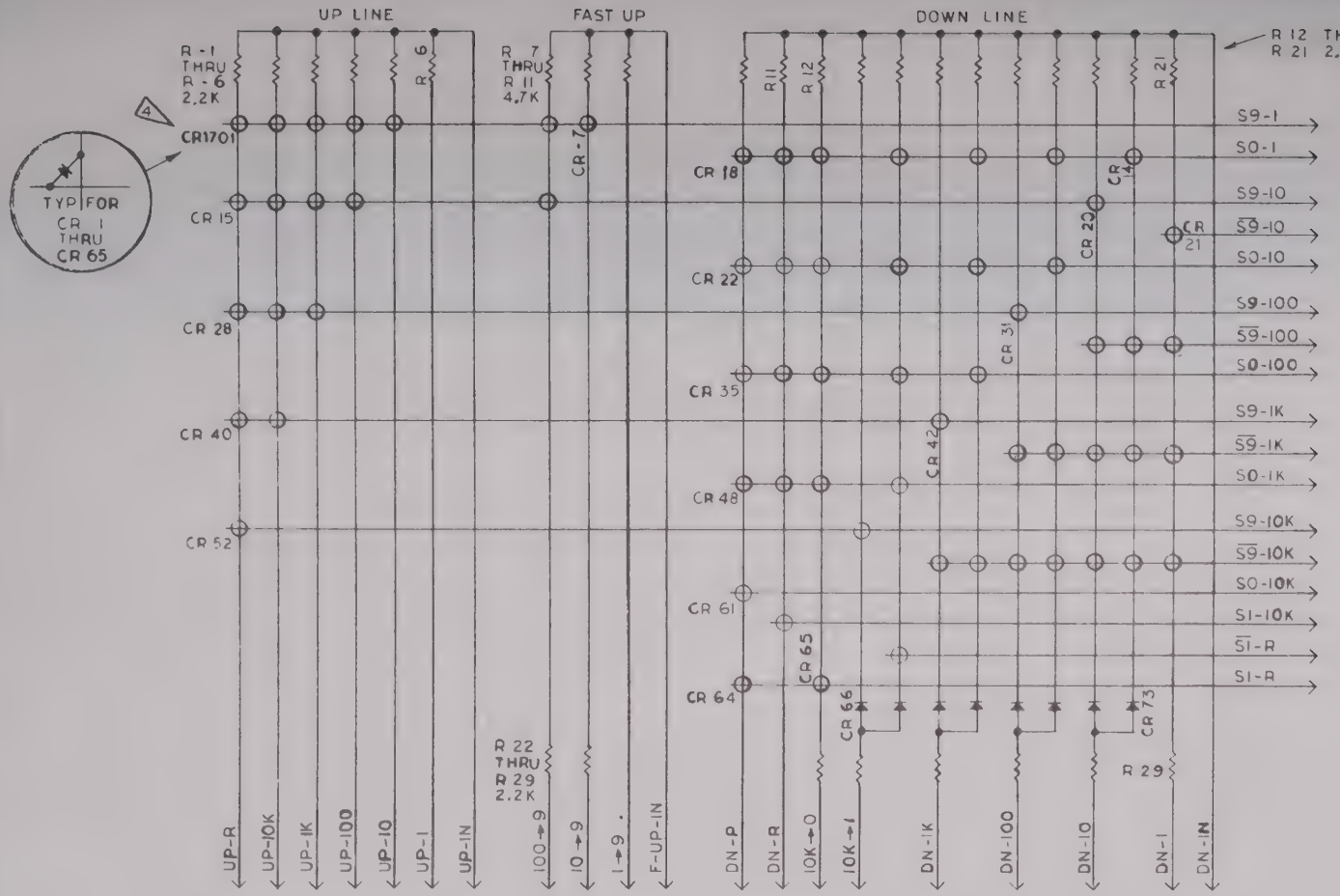


Figure 6-4. Logic Matrix Assembly.



76-0717
REL DATE

NOTES ◇

1. PLUG-IN PIN CONNECTIONS NOT SHOWN IN SAME ORDER AS ON ASSEMBLY.
2. ALL RESISTORS ±5%, 1/4 WATT.
3. ALL DIODES SAME TYPE.

4 PARTIAL REFERENCE DESIGNATORS USED. ALL DESIGNATORS ARE IN THE SERIES 1701 & ON. FOR COMPLETE DESIGNATOR ADD 1700 TO NUMBER SHOWN EXAMPLE R1 IS R1701

DRAWING SIZE C	SCHEMATIC — 76-6017 LOGIC MATRIX ASSY							CIMRON	
	DESIGN							76-0717	REV
	CHECK			CHF ENG					
7-30-7650	DRAFT			PROJECT					
MODEL		APPD	DATE		APPD	DATE	SCALE NONE	SHEET 1 OF 1	

PARTS LIST

CIMRON ASSEMBLY: Units through 1K Decade — CIMRON PART NO. 76-6018

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
CAPACITOR						
C1801 - C1805	560 pf	CER DISC		71590	DD-561	1-57500
C1806 - C1809	4.7 nf	MET PAP		12406	VX5A472K	1-57331
C1810	0.47 μf	MET PAP	50V	12406	VX5A474K	1-57318
C1811 - C1815	22 nf	MET PAP		12406	VX5A223K	1-57326
C1816 - C1817	0.22 μf	MET PAP	50V	12406	VX5A224K	1-57319
RESISTOR						
R1801	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1802	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1803	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1805	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1806	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1807	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1808	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1809	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1810	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1811 & R1814	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1815	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1816	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1817	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1818	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1819	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1820	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1823	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1824	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1825	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1826	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1827	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1828	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1829, R1830	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1831	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1832	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1833	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1834	5.6 KΩ	COMP	1/4W 5%	01121	CB-5625	7-41252
R1835	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1836, R1837	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1838	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1839	5.6 KΩ	COMP	1/4W 5%	01121	CB-5625	7-41252
R1840 - R1842	100 KΩ	COMP	1/4W 5%	01121	CB-1045	7-41267
R1843	220 KΩ	COMP	1/4W 5%	01121	CB-2245	7-41271
R1844 - R1846	100 KΩ	COMP	1/4W 5%	01121	CB-1045	7-41267
R1847 - R1850	47 KΩ	COMP	1/4W 5%	01121	CB-4735	7-41263
R1851	56 KΩ	COMP	1/4W 5%	01121	CB-5635	7-41264
R1852	4.7 KΩ	COMP	1/4W 5%	01121	CB-4725	7-41251

PARTS LIST

CIMRON ASSEMBLY: Units through 1K Decade — CIMRON PART NO. 76-6018

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
RESISTOR (Cont'd)						
R1853	1.5 KΩ	COMP	1/4W 5%	01121	CB-1525	7-41245
R1854 - R1858	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1859	47 KΩ	COMP	1/4W 5%	01121	CB-4735	7-41263
R1860	82 KΩ	COMP	1/4W 5%	01121	CB-8235	7-41266
R1861	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1862	56 KΩ	COMP	1/4W 5%	01121	CB-5635	7-41264
R1863	6.8 KΩ	COMP	1/4W 5%	01121	CB-6825	7-41253
R1864 - R1866	4.7 KΩ	COMP	1/4W 5%	01121	CB-4725	7-41251
R1867	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1868	4.7 KΩ	COMP	1/4W 5%	01121	CB-4725	7-41251
R1869	6.8 KΩ	COMP	1/4W 5%	01121	CB-6825	7-41253
R1870	56 KΩ	COMP	1/4W 5%	01121	CB-5635	7-41264
R1871, R1872	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1873 - R1882	470 KΩ	COMP	1/4W 5%	01121	CB-4745	7-41275
R1883	330 KΩ	COMP	1/4W 5%	01121	CB-3345	7-41273
R1884	100 KΩ	COMP	1/4W 5%	01121	CB-1045	7-41267
R1885	47 KΩ	COMP	1/4W 5%	01121	CB-4735	7-41263
SEMICONDUCTOR						
CR1801 - CR1852		CD-61 DIODE		15318		7-95511
TRANSISTOR						
Q1801 - Q1810				JEDEC	2N3567	9-04719
Q1811				JEDEC	2N1309	9-04611
Q1812 - Q1821		CT-22 or 2N3114		15318		9-04705
Q1822 - Q1823				JEDEC	2N3567	9-04719
Q1824 - Q1825				JEDEC	2N1309	9-04611
MISCELLANEOUS						
		ETCHED CIRCUIT BOARD		15318		76-7018-3

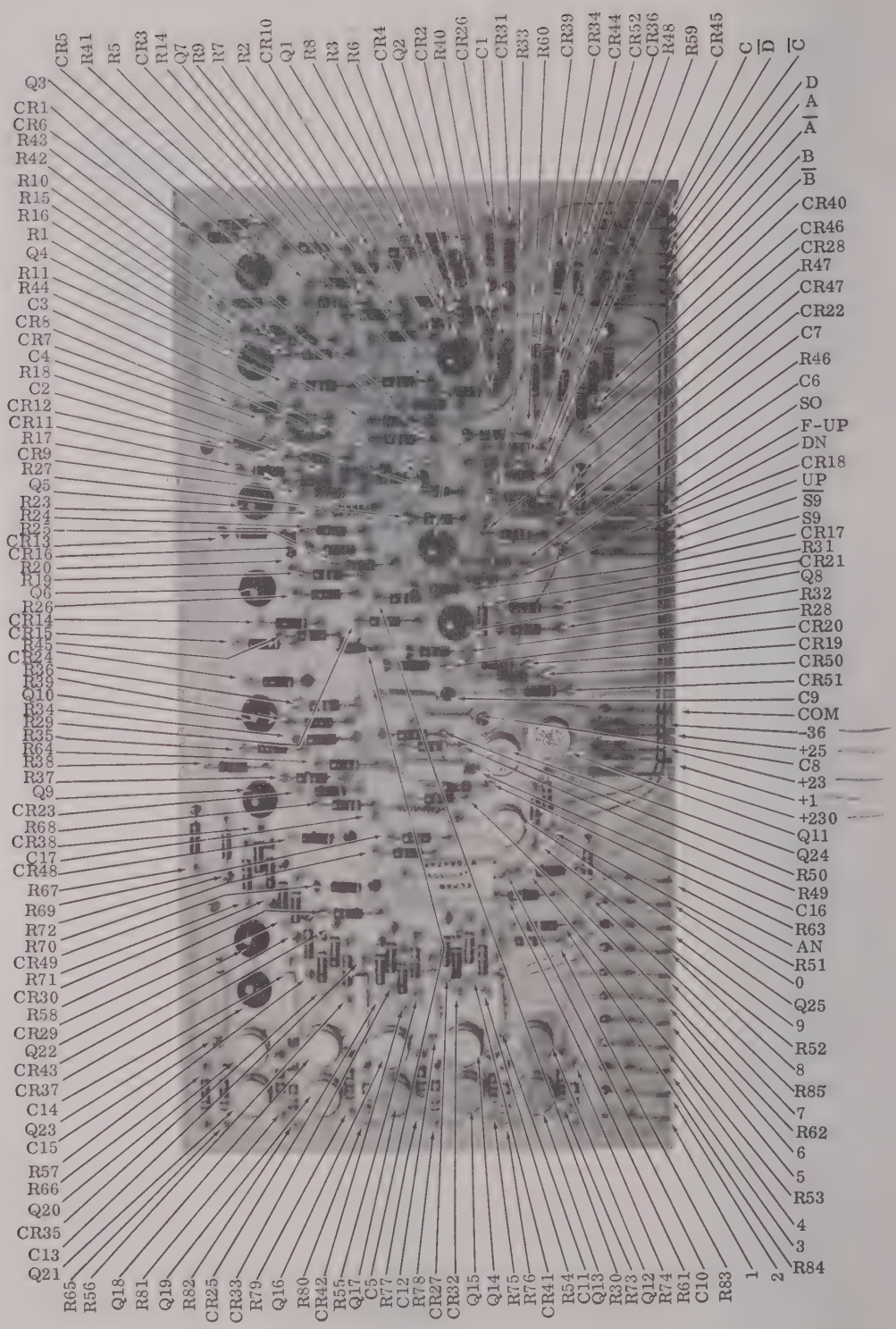
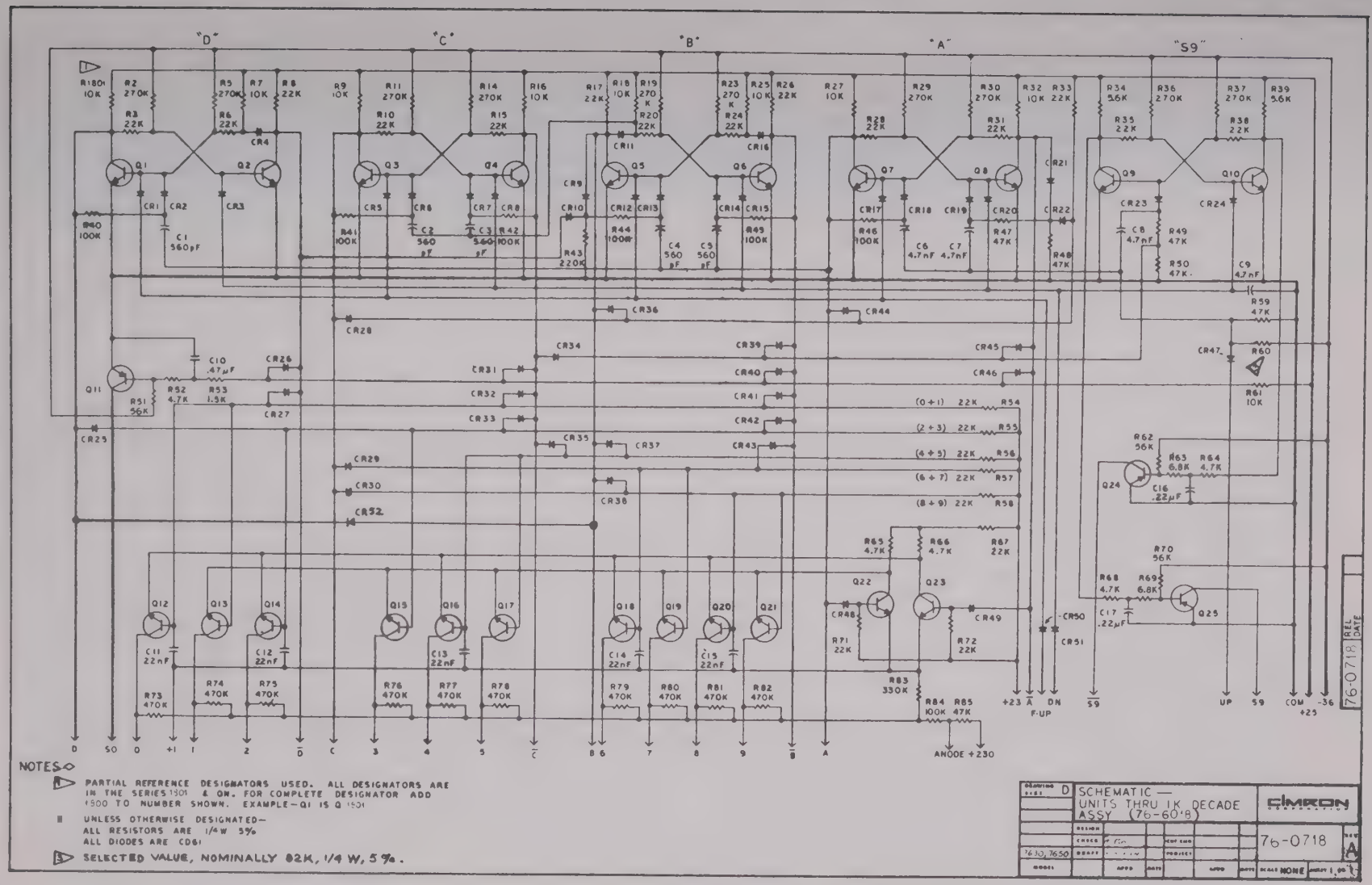


Figure 6-5. Units Through 1K Decade Assembly.


"D"
"C"
"B"
"A"
"S9"
NOTES
PARTIAL REFERENCE DESIGNATORS USED. ALL DESIGNATORS ARE IN THE SERIES 1501 & ON. FOR COMPLETE DESIGNATOR ADD 1500 TO NUMBER SHOWN. EXAMPLE—Q1 IS Q 1501
UNLESS OTHERWISE DESIGNATED— ALL RESISTORS ARE 1/4W 5% ALL DIODES ARE CD61
SELECTED VALUE, NOMINALLY 82K, 1/4 W, 5%.
SCHEMATIC — UNITS THRU 1K DECADE ASSY (76-6018)
CIMRON
76-0718
7630, 7650
SCALE NONE
D 50 0 +1 1 2 D C 3 4 5 B 6 7 8 9 A
ANODE +230
+23 A F-UP DN S9 UP S9 COM +25 -36
REEL DATE
76-0718

PARTS LIST

CIMRON ASSEMBLY: 10K Decade — CIMRON PART NO. 76-6011

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
CAPACITOR						
C1101 - C1105	560 pf	CER DISC		71590	DD-561	1-57500
C1106 - C1110	4.7 nf	PAP		12406	VX5A472K	1-57331
C1111 - C1112	0.47 μf	PAP	50V	12406	VX5A474K	1-57318
C1113 - C1117	22 nf	PAP		12406	VX5A223K	1-57326
C1118 - C1119	0.22 μf	PAP	50V	12406	VX5A224K	1-57319
RESISTOR						
R1101	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1102	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1103	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1105	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1106	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1107	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1108	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1109	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1110	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1111	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1114	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1115	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1116	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1117	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1118	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1119	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1120	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1123	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1124	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1125	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1126	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1127	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1128	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1129, R1130	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1131	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1132	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1133	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1134	5.6 KΩ	COMP	1/4W 5%	01121	CB-5625	7-41252
R1135	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1136, R1137	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1138	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1139	5.6 KΩ	COMP	1/4W 5%	01121	CB-5625	7-41252
R1140 - R1142	100 KΩ	COMP	1/4W 5%	01121	CB-1045	7-41267
R1143	220 KΩ	COMP	1/4W 5%	01121	CB-2245	7-41271
R1144 - R1146	100 KΩ	COMP	1/4W 5%	01121	CB-1045	7-41267
R1147 - R1150	47 KΩ	COMP	1/4W 5%	01121	CB-4735	7-41263
R1151	56 KΩ	COMP	1/4W 5%	01121	CB-5635	7-41264

PARTS LIST

CIMRON ASSEMBLY: 10K Decade — CIMRON PART NO. 76-6011

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
RESISTOR (Cont'd)						
R1152	4.7 KΩ	COMP	1/4W 5%	01121	CB-4725	7-41251
R1153	1.5 KΩ	COMP	1/4W 5%	01121	CB-1525	7-41245
R1154	56 KΩ	COMP	1/4W 5%	01121	CB-5635	7-41264
R1155	4.7 KΩ	COMP	1/4W 5%	01121	CB-4725	7-41251
R1156	1.5 KΩ	COMP	1/4W 5%	01121	CB-1525	7-41245
R1157	47 KΩ	COMP	1/4W 5%	01121	CB-4735	7-41263
R1158	Factory Selected Value					
R1159, R1160	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1161 - R1165	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1166	4.7 KΩ	COMP	1/4W 5%	01121	CB-4725	7-41251
R1167	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1168	4.7 KΩ	COMP	1/4W 5%	01121	CB-4725	7-41251
R1169, R1170	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1171	56 KΩ	COMP	1/4W 5%	01121	CB-5635	7-41264
R1172	6.8 KΩ	COMP	1/4W 5%	01121	CB-6825	7-41253
R1173, R1174	4.7 KΩ	COMP	1/4W 5%	01121	CB-4725	7-41251
R1175	6.8 KΩ	COMP	1/4W 5%	01121	CB-6825	7-41253
R1176	56 KΩ	COMP	1/4W 5%	01121	CB-5635	7-41264
R1177 - R1186	470 KΩ	COMP	1/4W 5%	01121	CB-4745	7-41275
R1187	330 KΩ	COMP	1/4W 5%	01121	CB-3345	7-41273
R1188	100 KΩ	COMP	1/4W 5%	01121	CB-1045	7-41267
R1189	47 KΩ	COMP	1/4W 5%	01121	CB-4735	7-41263
SEMICONDUCTOR						
CR1101 - CR1157		CD-61 DIODE		15318		7-95511
TRANSISTOR						
Q1101 - Q1110				JEDEC	2N3567	9-04719
Q1111, Q1112				JEDEC	2N1309	9-04611
Q1113 - Q1122		CT-22 or 2N3114		15318		9-04705
Q1123, Q1124				JEDEC	2N3567	9-04719
Q1125, Q1126				JEDEC	2N1309	9-04611
MISCELLANEOUS						
		ETCHED CIRCUIT BOARD		15318		76-7011-1

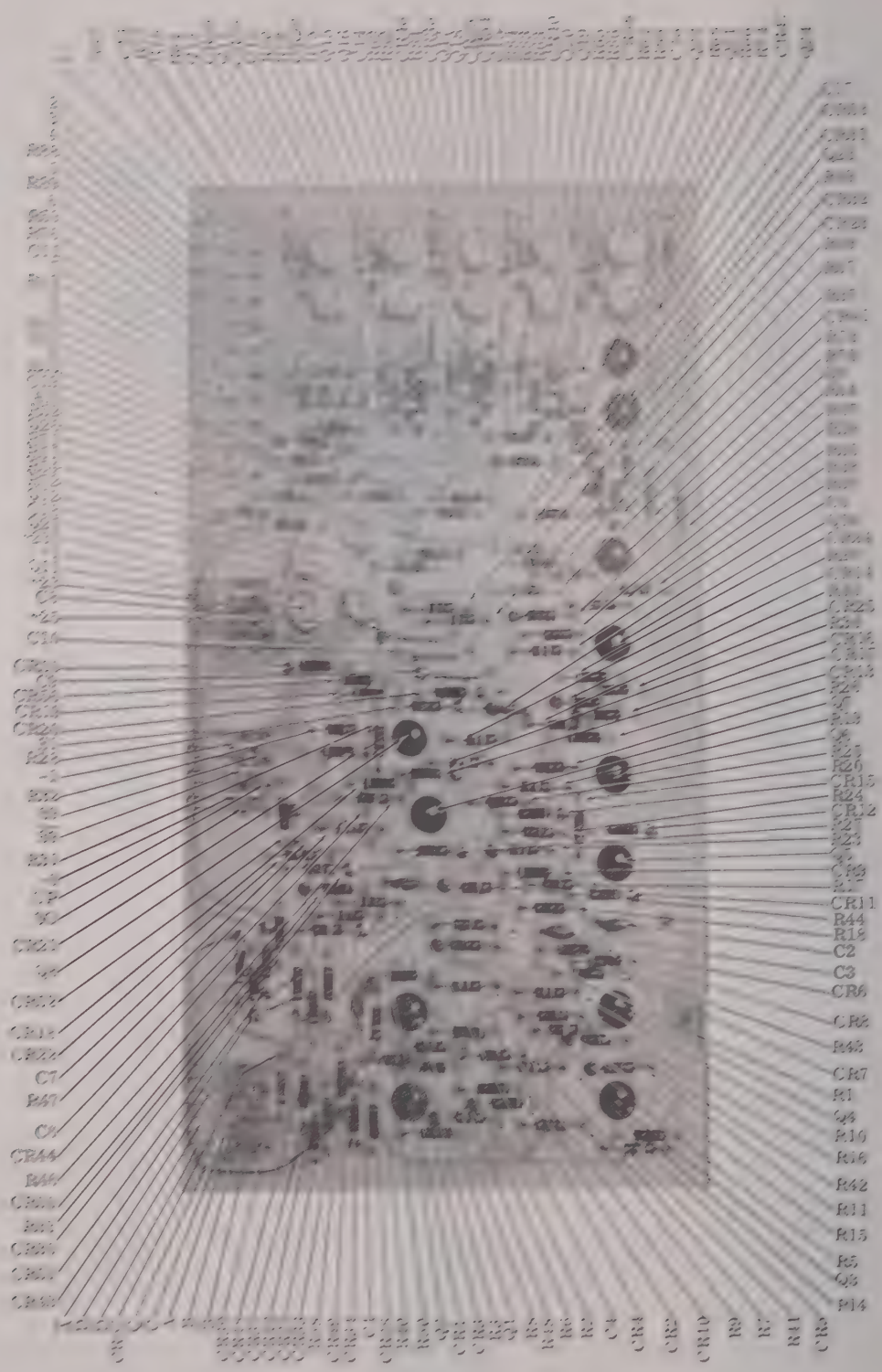
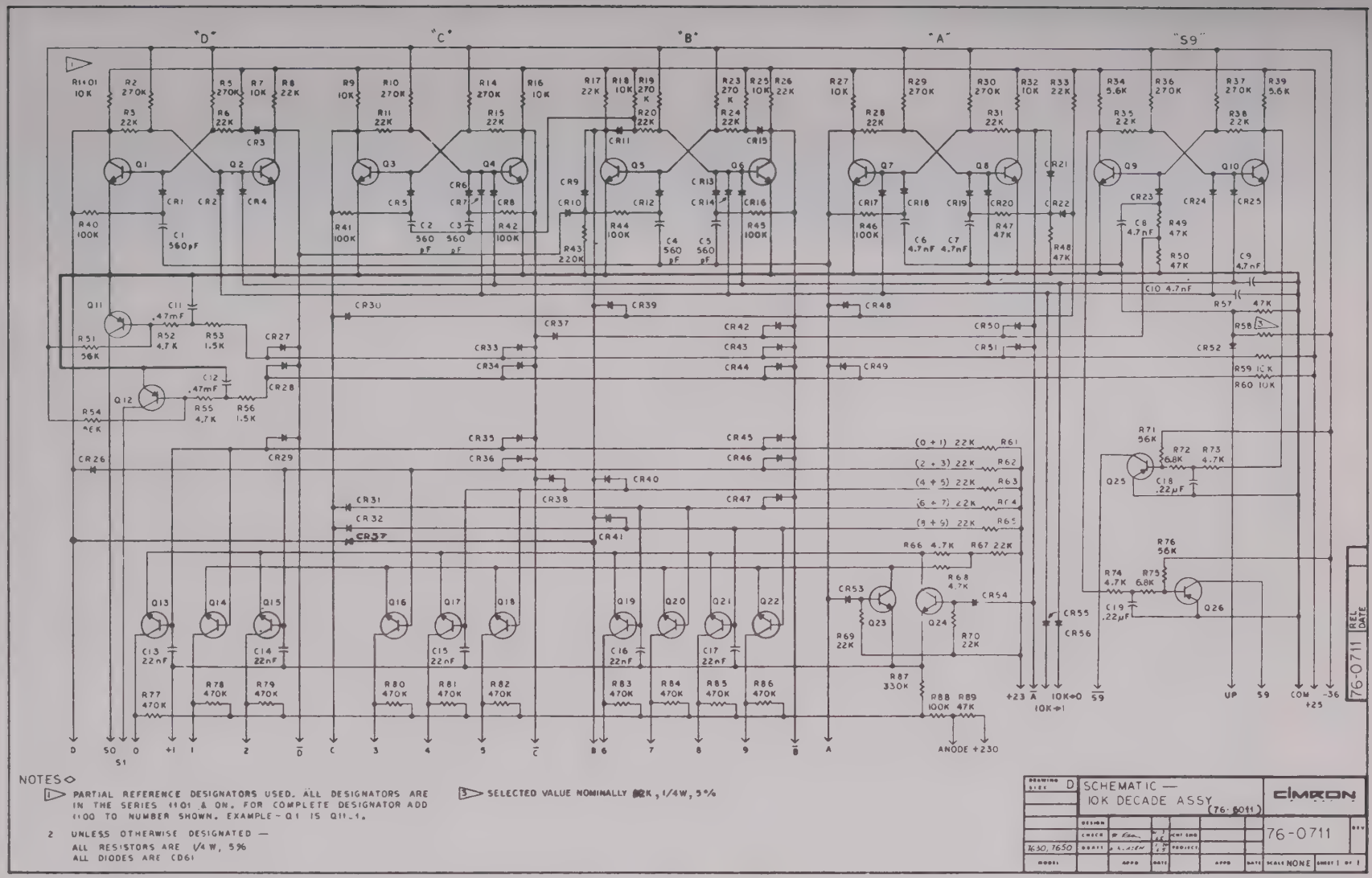


Figure 6-6. 10K Decade Assembly.



NOTES◇

1. PARTIAL REFERENCE DESIGNATORS USED. ALL DESIGNATORS ARE IN THE SERIES 1101 & ON. FOR COMPLETE DESIGNATOR ADD 1100 TO NUMBER SHOWN. EXAMPLE - Q1 IS Q1101.
2. UNLESS OTHERWISE DESIGNATED — ALL RESISTORS ARE 1/4 W, 5% ALL DIODES ARE CD61
3. SELECTED VALUE NOMINALLY 82K, 1/4W, 5%

DRAWING SIZE D	SCHEMATIC — 10K DECADE ASSY (76-0711)		CIMRON
DESIGN			76-0711
CHECK W. Ross			
1630, 1650 MODEL	DRAFT J. KAUFFMAN	PROJECT	SCALE NONE SHEET 1 OF 1

PARTS LIST

CIMRON ASSEMBLY: Range and Polarity — CIMRON PART NO. 76-6014

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
CAPACITOR						
C1401, C1402	0.22 μf	MET PAP	50V	12406	VX5A224K	1-57319
C1403, C1404	1.8 nf	CER DISC	1000V	71590	DD-182	1-57303
C1405	47 nf	MET PAP	50V	12406	VX5A473K	1-57327
C1406, C1407	4.7 nf	MET PAP	50V	12406	VX5A472K	1-57331
RESISTOR						
R1401	120 KΩ	COMP	1/2W 5%	01121	EB-1245	7-41068
R1402	15 KΩ	COMP	1/2W 5%	01121	EB-1535	7-41057
R1403	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1404	4.7 KΩ	COMP	1/2W 5%	01121	EB-4725	7-41051
R1405	120 KΩ	COMP	1/2W 5%	01121	EB-1245	7-41068
R1406	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1407	1 MΩ	COMP	1/2W 5%	01121	EB-1055	7-41079
R1408, R1409	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071
R1410	1 MΩ	COMP	1/2W 5%	01121	EB-1055	7-41079
R1411	120 KΩ	COMP	1/2W 5%	01121	EB-1245	7-41068
R1412	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1413	4.7 KΩ	COMP	1/2W 5%	01121	EB-4725	7-41051
R1414	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1415	15 KΩ	COMP	1/2W 5%	01121	EB-1535	7-41057
R1416	120 KΩ	COMP	1/2W 5%	01121	EB-1245	7-41068
R1417, R1418	5Ω	COMP WW	3%	04387	RS-1/2	7-47176
R1419, R1420	470 KΩ	COMP	1/2W 5%	01121	EB-4745	7-41075
R1421, R1422	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055
R1423	120 KΩ	COMP	1/2W 5%	01121	EB-1245	7-41068
R1424	68 KΩ	COMP	1/2W 5%	01121	EB-6835	7-41065
R1425, R1426	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055
R1427	39 KΩ	COMP	1/2W 5%	01121	EB-3935	7-41062
R1428, R1429	15 KΩ	COMP	1/2W 5%	01121	EB-1535	7-41057
R1430	68 KΩ	COMP	1/2W 5%	01121	EB-6835	7-41065
R1431	4.7 KΩ	COMP	1/2W 5%	01121	EB-4725	7-41051
R1432, R1433	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1434, R1435	4.7 KΩ	COMP	1/2W 5%	01121	EB-4725	7-41051
R1436	120 KΩ	COMP	1/2W 5%	01121	EB-1245	7-41068
R1437	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1438, R1439	1 MΩ	COMP	1/2W 5%	01121	EB-1055	7-41079
R1440	120 KΩ	COMP	1/2W 5%	01121	EB-1245	7-41068
R1441	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1442	4.7 KΩ	COMP	1/2W 5%	01121	EB-4725	7-41051
R1443 - R1445	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071
R1446, R1447	47 KΩ	COMP	1/2W 5%	01121	EB-4735	7-41063
R1448	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071
R1449	120 KΩ	COMP	1/2W 5%	01121	EB-1245	7-41068
R1450, R1451	4.7 KΩ	COMP	1/2W 5%	01121	EB-4725	7-41051

PARTS LIST

CIMRON ASSEMBLY: Range and Polarity — CIMRON PART NO. 76-4014

SCHEMATIC DESIGNATION	DESCRIPTION: VALUE	DESCRIPTION: TYPE	DESCRIPTION: RATING	MANUFACTURER: CODE	MANUFACTURER: PART NO.	CIMRON PART NO.
RESISTOR (Cont'd)						
R1401	10 KΩ	COMP	1/2W 5%	01121	EB-1035	T-41067
R1402	470 KΩ	COMP	1/2W 5%	01121	EB-4745	T-41073
R1403	150 KΩ	COMP	1/2W 5%	01121	EB-2245	T-41071
R1404	1.0 KΩ	COMP	1/2W 5%	01121	EB-1025	T-41065
R1405	470 KΩ	COMP	1/2W 5%	01121	EB-4745	T-41073
R1406	150 KΩ	COMP	1/2W 5%	01121	EB-2245	T-41071
R1407	470 KΩ	COMP	1/2W 5%	01121	EB-4745	T-41073
R1408	220 KΩ	COMP	1/2W 5%	01121	EB-2245	T-41071
R1409 - R1440	6.8 KΩ	COMP	1/2W 5%	01121	EB-6825	T-41069
SEMICONDUCTOR						
CR1401 - CR1440		CD-41 DIODE		15818		T-86511
CR1441		ZENER DIODE		JEDEC	1N712	T-86611
CR1442 - CR1446		CD-41 DIODE		15818		T-86511
CR1447 - CR1448		CD-41 DIODE		15818		T-86511
CR1449 - CR1450		CD-41 DIODE		15818		T-86511
TRANSISTOR						
Q1401 - Q1402				JEDEC	2N5449	T-84811
Q1403 - Q1404				JEDEC	2N5947	T-84713
Q1405 - Q1407		TT-21 or 2N3114		15818		T-84706
Q1408				JEDEC	2N5449	T-84811
Q1409 - Q1409				JEDEC	2N1305	T-84611
Q1410 - Q1414				JEDEC	2N5947	T-84713
Q1415 - Q1417				JEDEC	2N5449	T-84811
MISCELLANEOUS						
L1401 - L1404		REED SWITCH ACTIVATOR SOLENOID		15818		76-4014-1
S1401 - S1404		RELAY SWITCH MAG REED		12817	DRR-1	T-86114
		ETCHED CIRCUIT BOARD		15818		76-7014-1

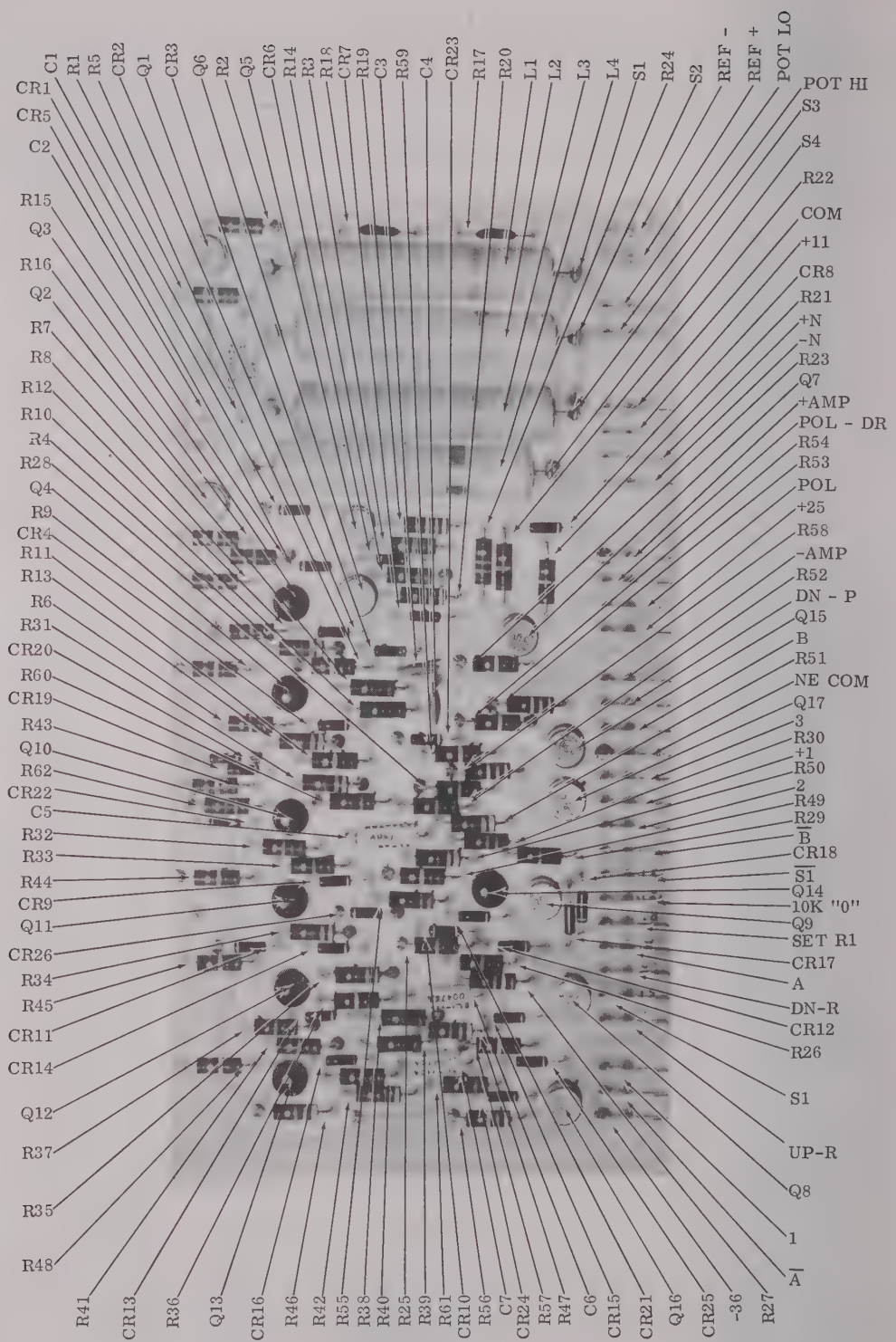
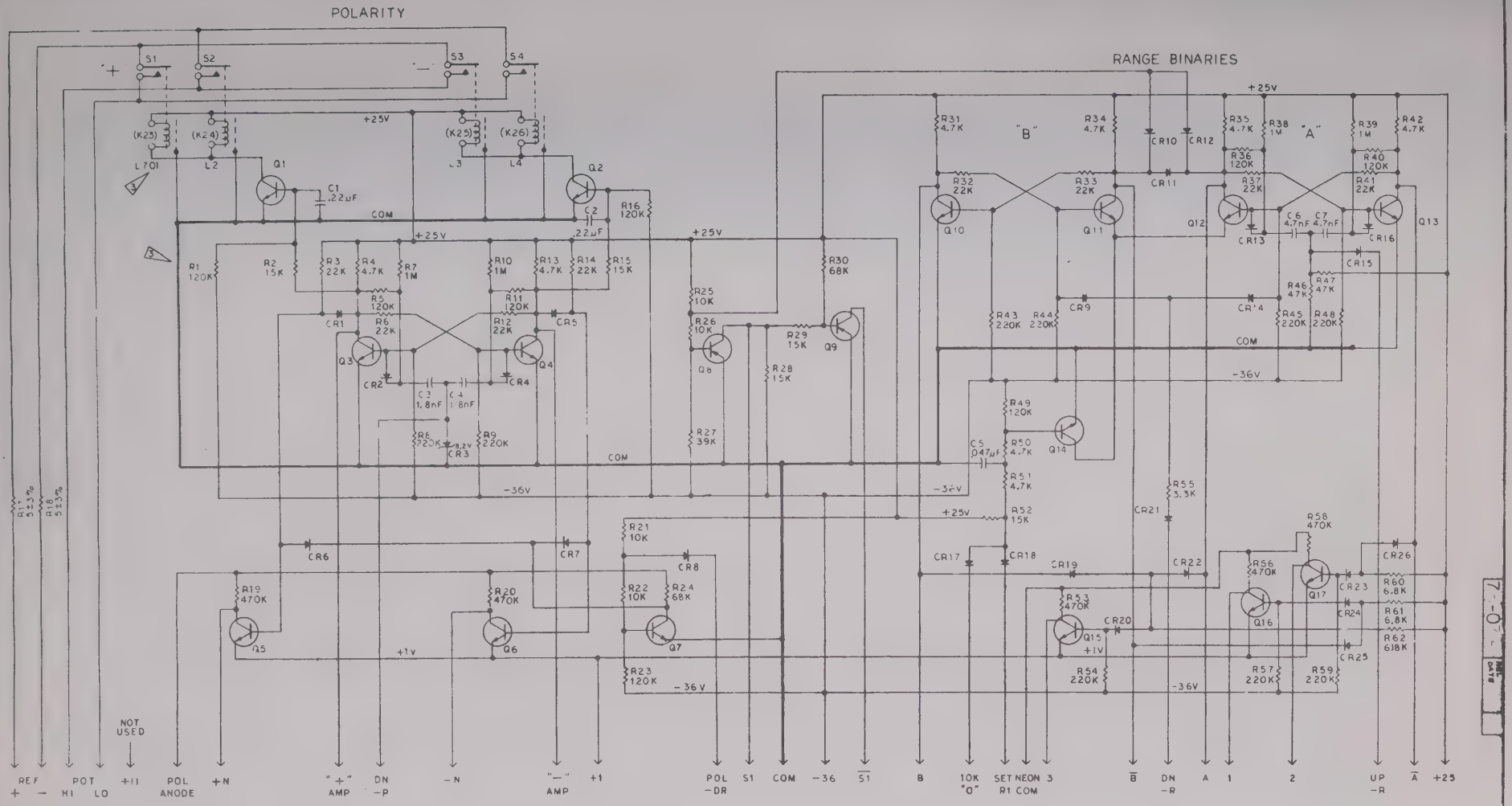


Figure 6-7. Range and Polarity Assembly.



NOTES ◇

1. PLUG-IN PIN CONNECTIONS NOT SHOWN IN SAME ORDER AS ON ASSEMBLY.
2. UNLESS OTHERWISE NOTED, RESISTORS ARE ½ WATT & ±5% TOLERANCE.

3 PARTIAL REFERENCE DESIGNATIONS SHOWN. ALL NUMBERS ARE IN THE SERIES 100 & ON. EXAMPLE: R1 IS R101

DRAWING SIZE D	SCHEMATIC — 76-6014 RANGE & POLARITY ASSY	CIMRON	
DESIGN			
CHECK			76-0714
7000 SERIES	DRAFT	PROJECT	
MODELS	APP'D DATE	APP'D DATE	SCALE NONE SHEET

6-29

7-0-7

PARTS LIST

CIMRON ASSEMBLY: Reference and Ratio — CIMRON PART NO. 76-6024

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
RESISTOR						
R2401	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R2402	5.6 KΩ	COMP	1/4W 5%	01121	CB-5625	7-41252
R2403	120 KΩ	COMP	1/4W 5%	01121	CB-1245	7-41268
R2404	5 KΩ	VAR TRIM WW		97704	1PC5K	7-54241
R2405	200Ω	VAR TRIM WW		97704	1PC200Ω	7-54239
R2406, R2407	Factory Selected Value					
SEMICONDUCTOR						
CR2401 - CR2404		CD-61 DIODE		15318		7-95511
TRANSISTOR						
Q2401				JEDEC	2N3567	9-04719
MISCELLANEOUS						
Z2401	VOLTAGE REFERENCE STANDARD .1 MA			15318		76-0501-1
K2401, K2402	RELAY 3 PDT			21226	12-BW3-G	7-38215
	ETCHED CIRCUIT BOARD			15318		76-7024-3

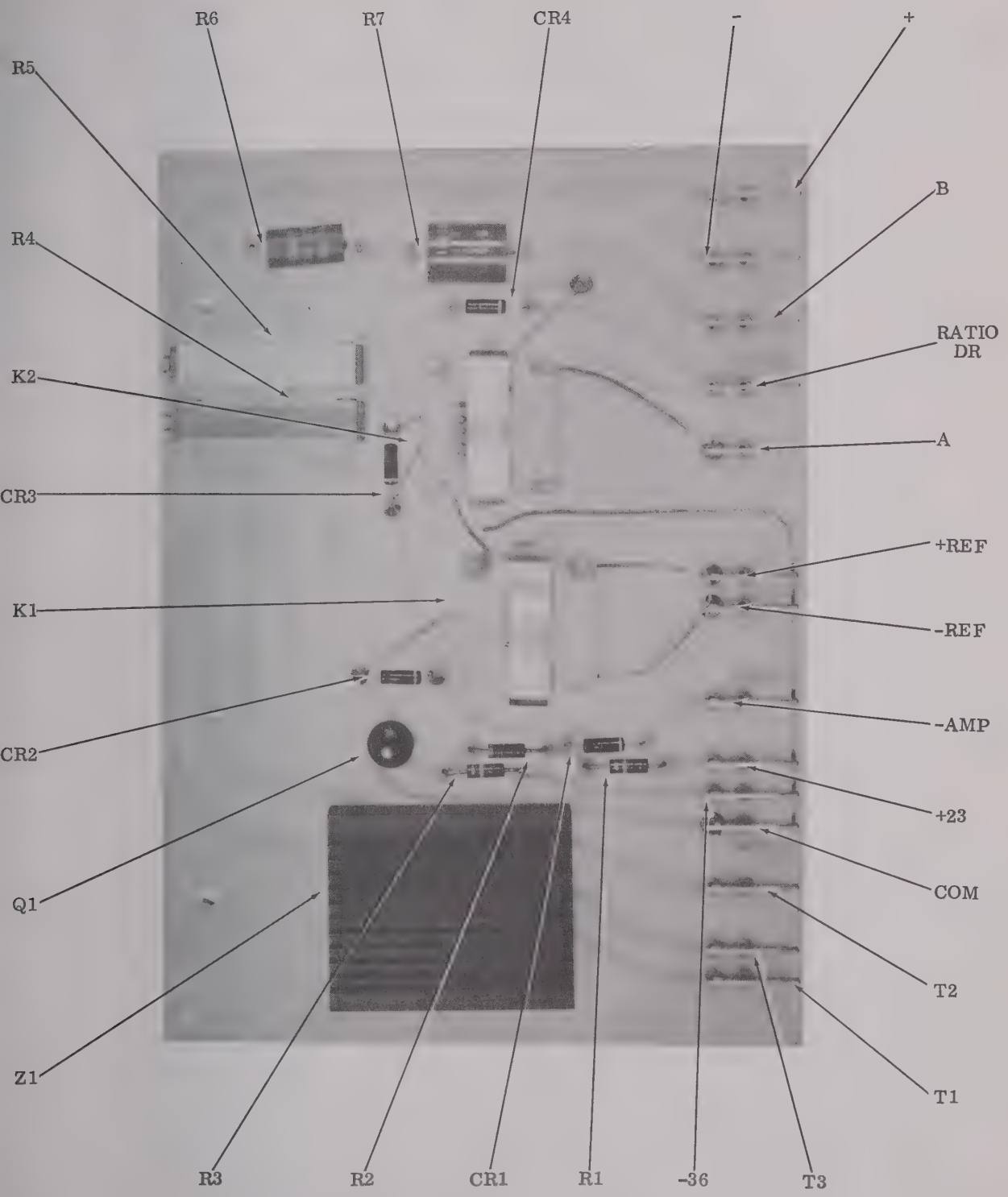
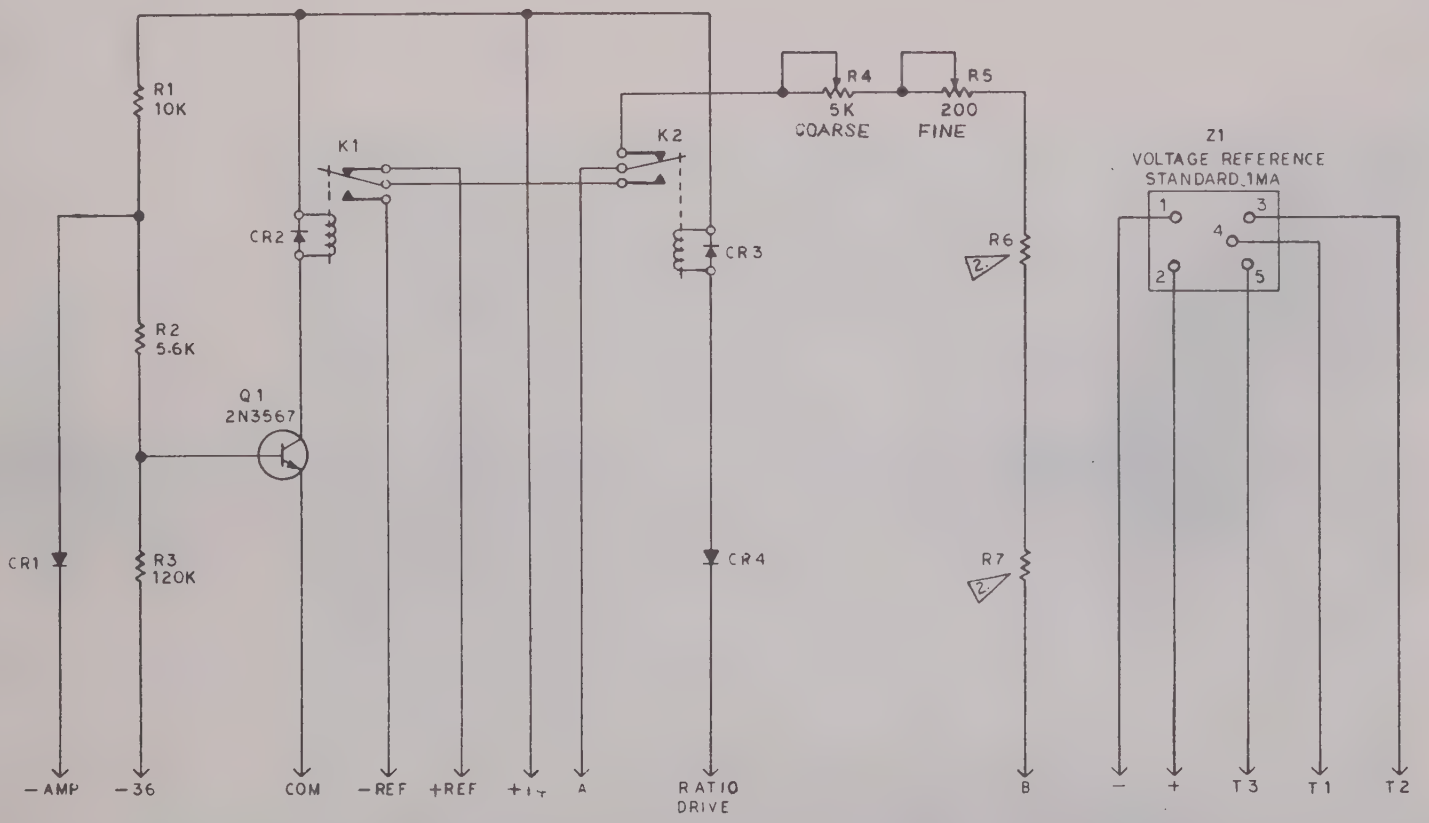


Figure 6-8. Reference and Ratio Assembly.



NOTES◇

1. ALL RESISTORS ARE ±5%, 1/4W UNLESS NOTED OTHERWISE.
2. FACTORY SELECTED VALUE.
3. CR1-4 ARE CD-61.
4. LAST NO USED: CR4, K2, Q1, R7, Z1. | NO'S NOT USED: NONE
5. PARTIAL REFERENCE DESIGNATIONS SHOWN. FOR COMPLETE DESIGNATOR ADD 2400 EXAMPLE R1 IS R2401

MODEL
7650
7630

CHF ENG		
PROJECT		
DESIGN		
CHECK		
DRAFT	B. HALES	1/5/66

76-0724

REL DATE: A

DRAWING SIZE: C

SCHEMATIC
REFERENCE & RATIO SW
ASSY 76-6024

CIMRON CORPORATION

76-0724 REV A

PARTS LIST

IMRON ASSEMBLY: "A" Potentiometer — CIMRON PART NO. 76-6019

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
RESISTOR						
R1901 - R1906*	20 KΩ	WW RATIOED		15318		5-40011*
R1907 - R1910*	2 KΩ	WW RATIOED		15318		5-40011*
R1911	Factory Selected Value					
R1912	1110.1Ω	PRECISION	0.01%	07088	OB	7-47119
R1913, R1914*	2 KΩ	WW RATIOED		15318		5-40011*
R1915	2 KΩ	PRECISION	0.025%	07088	OB	7-47117
R1916	4 KΩ	PRECISION	0.025%	07088	OB	7-47118
SEMICONDUCTOR						
CR1901 - CR1920		CD-61 DIODE		15318		7-95511
MISCELLANEOUS						
K1901 - K1910		LOW THERMAL SWITCH		15318		70-0509
		ETCHED CIRCUIT BOARD		15318		76-7019-1

*These resistors must be replaced as one unit under Part Number 5-40011.

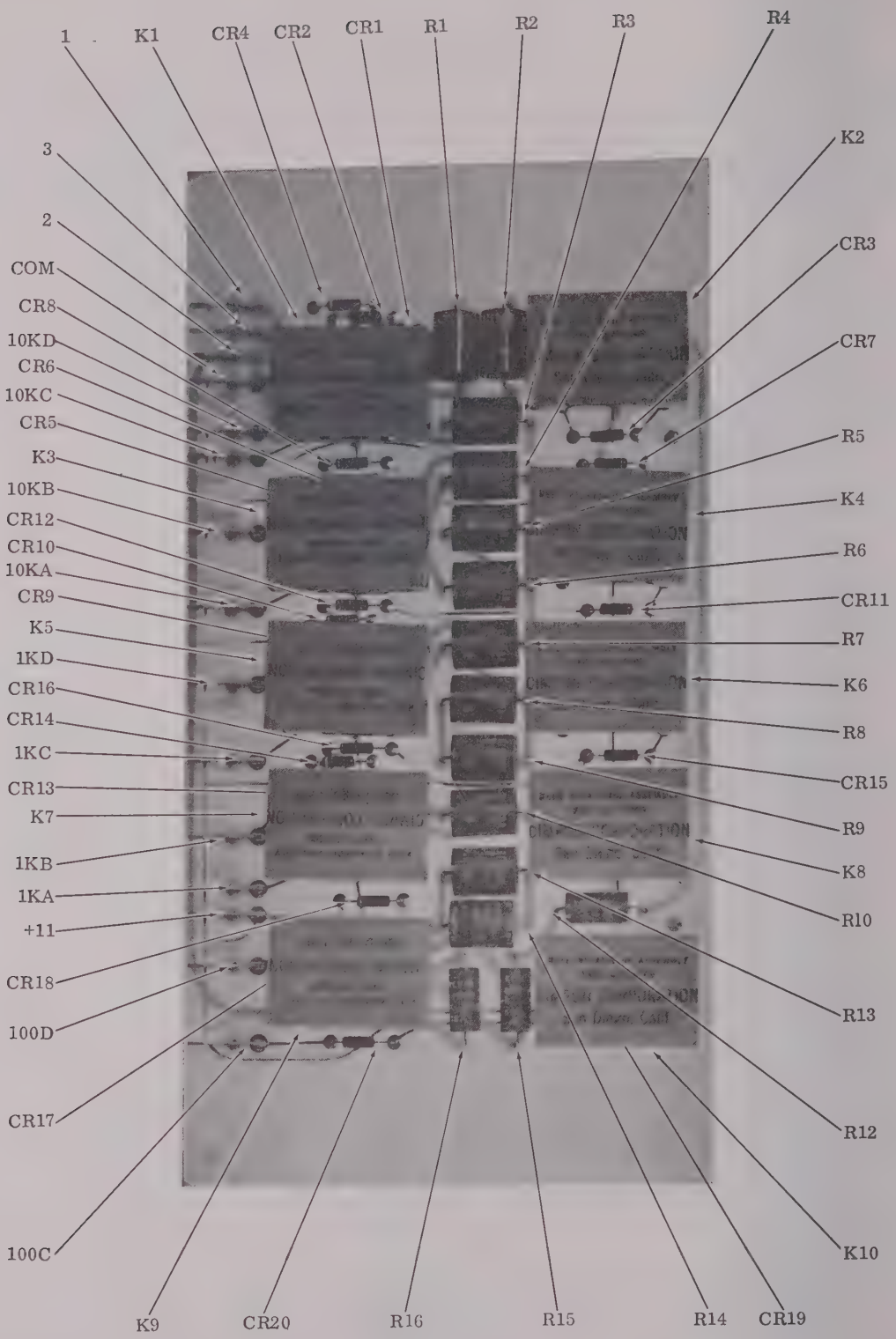
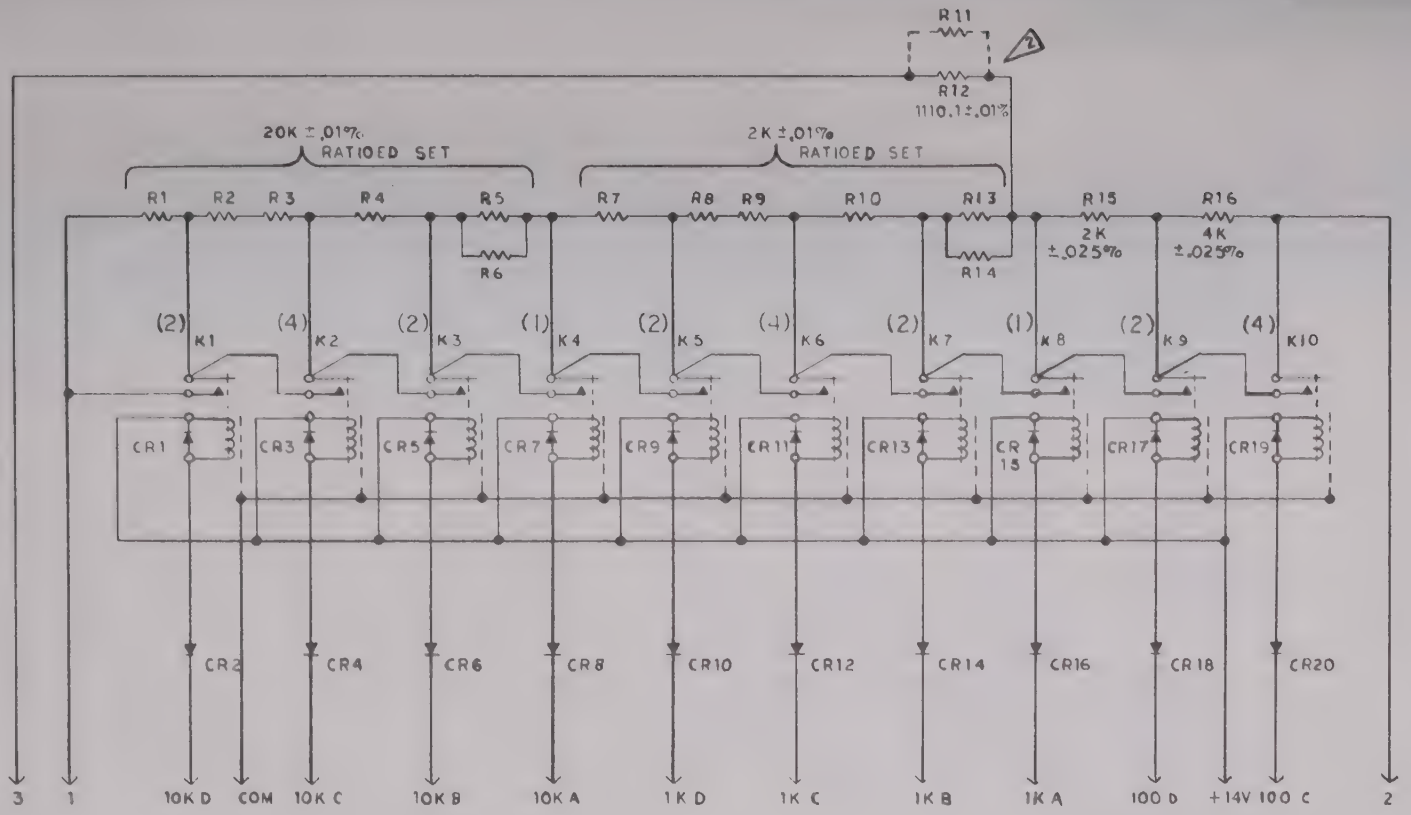


Figure 6-9. A Potentiometer Assembly.



NOTES◇

1. THESE ASSEMBLIES ARE INSTALLED AS MATCHED PAIRS AND ARE NOT INDIVIDUALLY REPLACEABLE.
2. R12 USED IN 76-6019-1 ASSY ONLY
   R11 IS SELECTED VALUE NOMINALLY 1Ω, 2W, WW
   USED IN 76-6019-2 ASSY ONLY.
3. LAST NO USED: CR20, K10, R16. | NO'S NOT USED: NONE
4. ALL DIODES ARE CD-61
5. PARTIAL REFERENCE DESIGNATIONS SHOWN
   FOR COMPLETE DESIGNATES ADD 1600
   EXAMPLE R1 IS K1601

MODEL
7650
7630

CHF ENG		
PROJECT		
DESIGN		
CHECK		
DRAFT	BCHARLES	1/20/66

76-0719

REL DATE

DRAWING SIZE C

SCHEMATIC

"A" POTENTIO-METER

ASSY 76-6019

CIMRON

76-0719 REV

PARTS LIST

CIMRON ASSEMBLY: "B" Potentiometer — CIMRON PART NO. 76-6020

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
RESISTOR						
R2001	2 KΩ	PRECISION	0.025%	07088	OB	7-47117
R2002	1 KΩ	PRECISION	0.025%	07088	OB	7-47126
R2003	200Ω	PRECISION	0.05%	07088	OD	7-47112
R2004	400Ω	PRECISION	0.025%	07088	OD	7-47113
R2005	200Ω	PRECISION	0.05%	07088	OD	7-47112
R2006	100Ω	PRECISION	0.1%	07088	OD	7-47111
R2007	20Ω	PRECISION	0.5%	07088	OD	7-47109
R2008	40Ω	PRECISION	0.25%	07088	OD	7-47110
R2009	20Ω	PRECISION	0.5%	07088	OD	7-47109
R2010	10Ω	PRECISION	1%	07088	OD	7-47108
SEMICONDUCTOR						
CR2001 - CR2020		CD-61 DIODE		15318		7-95511
MISCELLANEOUS						
K2001 - K2010		LOW THERMAL SWITCH		15318		70-0509
		ETCHED CIRCUIT BOARD		15318		76-7020-1

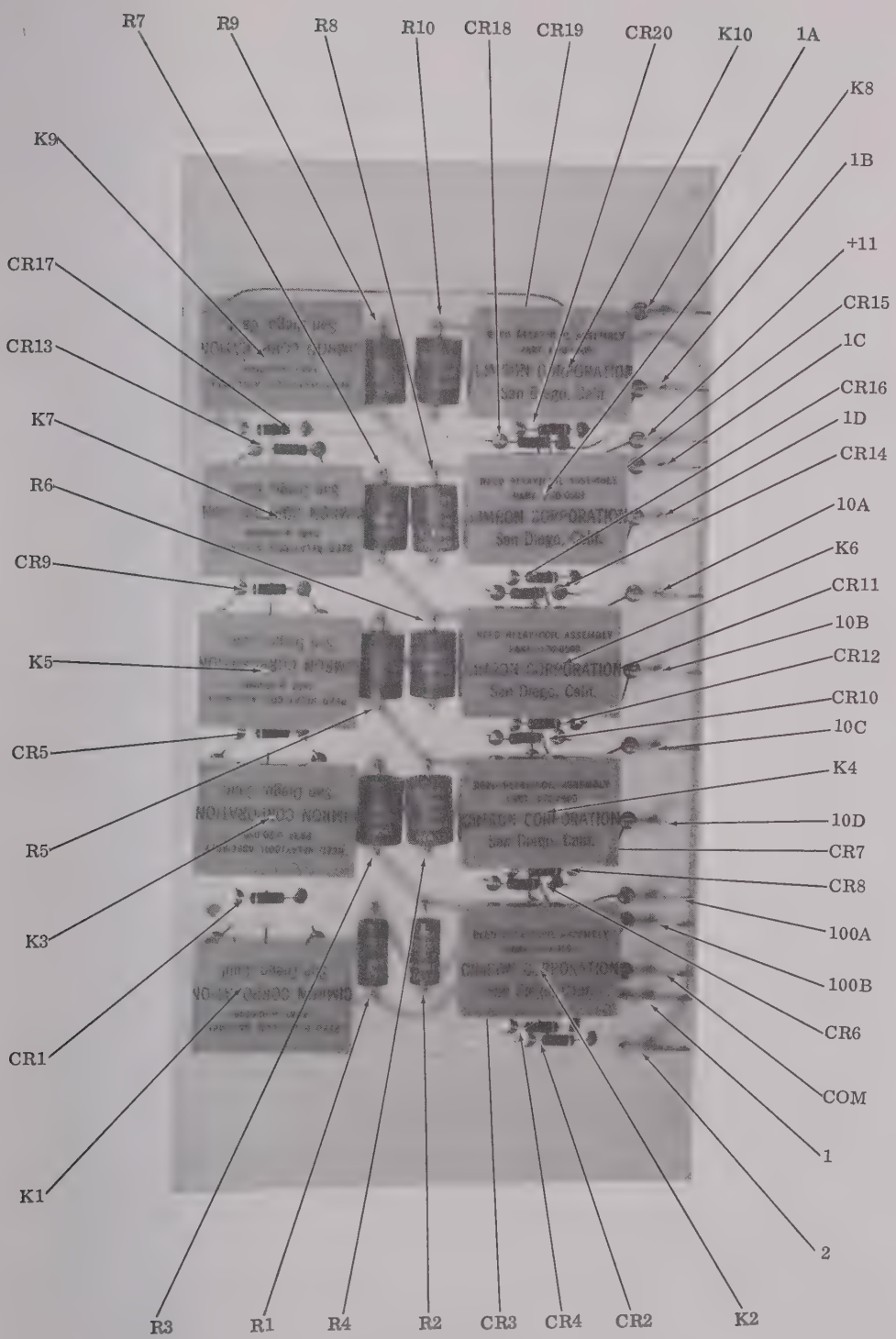
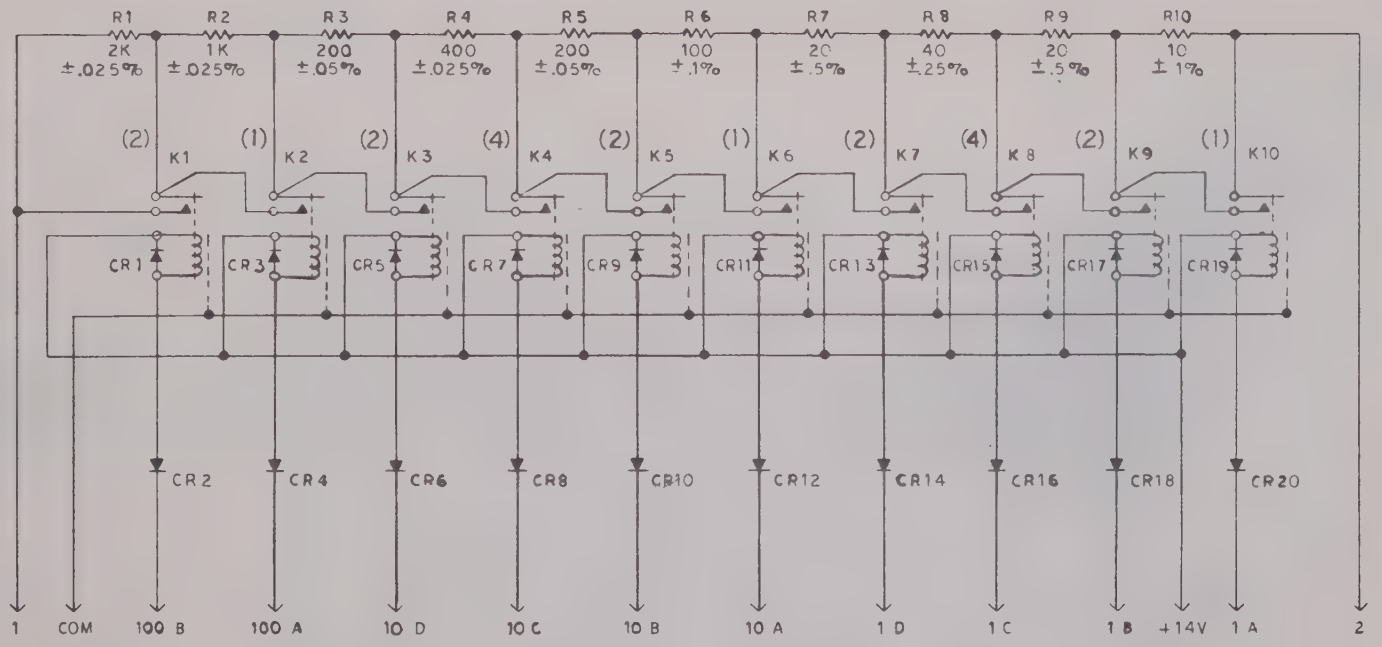


Figure 6-10. B Potentiometer Assembly.



NOTES ◇

1. ALL DIODES ARE CD-61.
2. LAST NO. USED: CR20, K10, R10. | NO'S NOT USED: NONE
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR ADD 2000 EXAMPLE K1 IS K2001

MODEL
7650
7630

CHF ENG		
PROJECT		
DESIGN		
CHECK		
DRAFT	A. HARRIS	9/11/66

76-0720

REL DATE

DRAWING SIZE C

SCHEMATIC

"B" POTENTIO-METER

ASSY 76-6020

CIMRON

76-0720 REV

PARTS LIST

CIMRON ASSEMBLY: Print Control — CIMRON PART NO. 76-6023

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
CAPACITOR						
C2301	1 μf	PAP	50V	12406	VX5A105K	1-57317
C2302	1.8 nf	CER DISC		71590	DD-182	1-57503
C2303, C2304	20 μf	ELECT	50V	14655	NLW 20-50	1-57256
RESISTOR						
R2301	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R2302	47 KΩ	COMP	1/2W 5%	01121	EB-4735	7-41063
R2303	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R2304	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055
R2305	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071
R2306	47 KΩ	COMP	1/2W 5%	01121	EB-4735	7-41063
R2307	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R2308	1 MΩ	VAR	1/8W	11237	220S105B	7-48806
R2309	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R2310	330Ω	COMP	1/2W 5%	01121	EB-3315	7-41037
R2311	3.3 KΩ	COMP	1/2W 5%	01121	EB-3325	7-41049
R2312	15 KΩ	COMP	1/2W 5%	01121	EB-1535	7-41057
R2313	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071
R2314	15 KΩ	COMP	1/2W 5%	01121	EB-1535	7-41057
R2315	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071
R2316	100 KΩ	COMP	1/2W 5%	01121	EB-1045	7-41067
R2317	5.6 KΩ	COMP	1/2W 5%	01121	EB-5625	7-41052
R2318	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055
R2319	100Ω	COMP	1/2W 5%	01121	EB-1015	7-41031
R2320	27 KΩ	COMP	1/2W 5%	01121	EB-2735	7-41060
R2321	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071
R2322	15 KΩ	COMP	1/2W 5%	01121	EB-1535	7-41057
R2323	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055
R2324	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071
SEMICONDUCTOR						
CR2301 - CR2314		CD-61 DIODE		15318		7-95511
TRANSISTOR						
Q2301 - Q2303				JEDEC	2N3567	9-04719
Q2304		UNIJUNCTION		JEDEC	2N2647, 4JD5E29 or 4JDX5E738	9-04400
Q2305 - Q2308				JEDEC	2N3567	9-04719
MISCELLANEOUS						
K2301		REED		15318		70-0511-1
K2302		REED COIL		15318		70-0501-1
S2301		REED SWITCH		95348	MR-306-8	7-38216
S2302		REED SWITCH		12617	DRG-1	7-38208
		ETCHED CIRCUIT BOARD		15318		76-7023-3

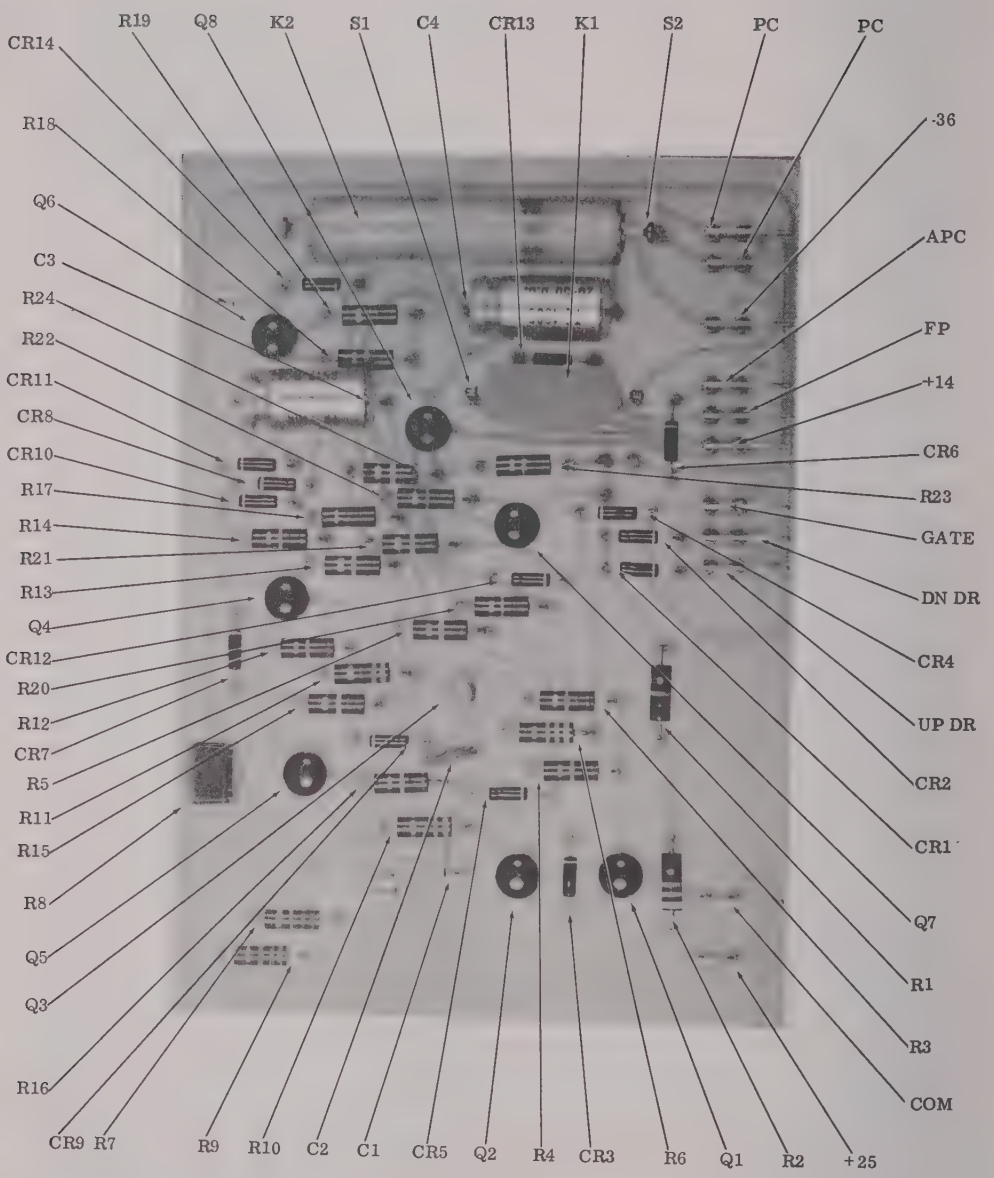
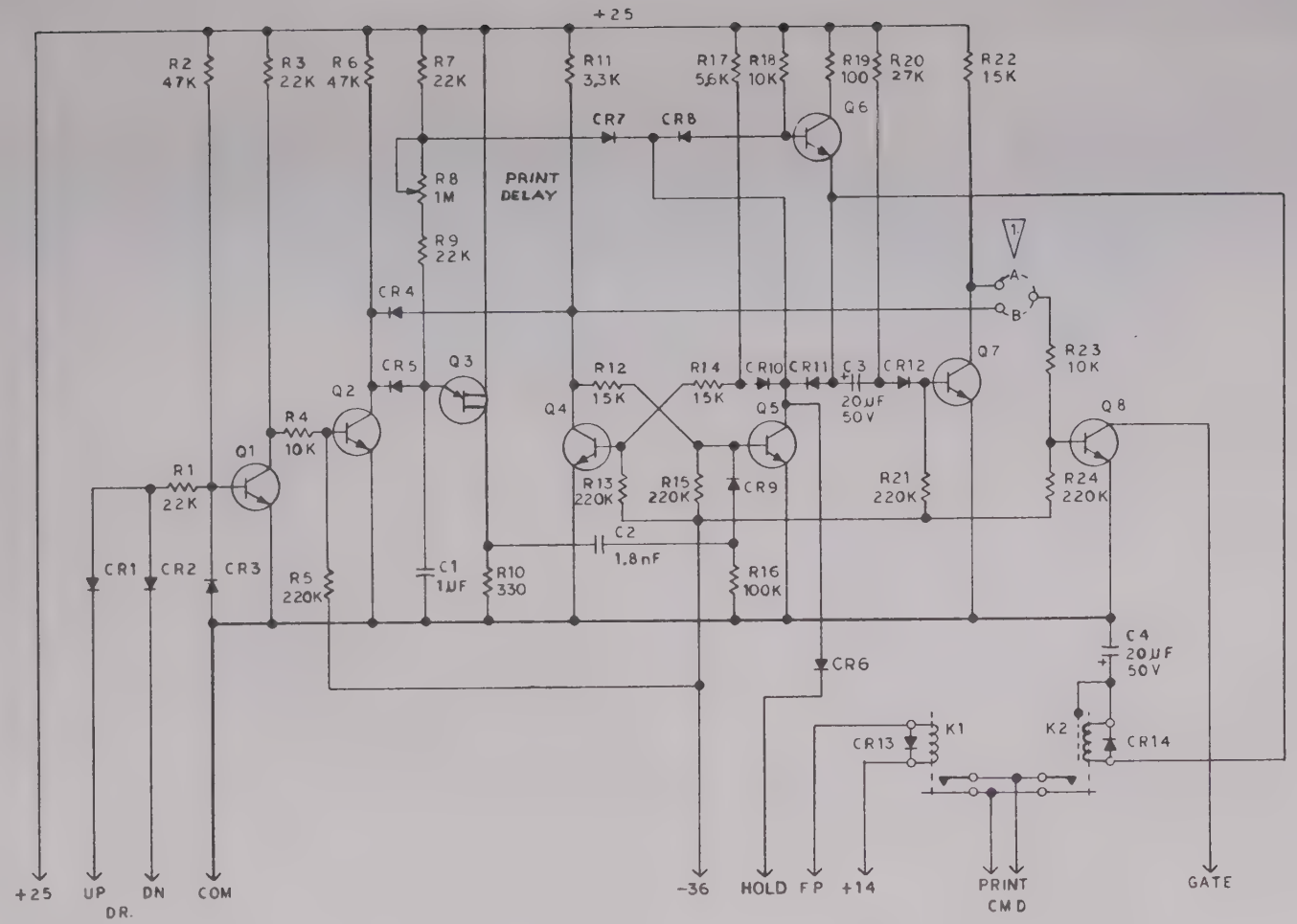


Figure 6-11. Print Control Assembly.



NOTES

1. THE CIRCUIT BOARD WILL NORMALLY BE ASSEMBLED AND SHIPPED WITH JUMPER "A" INSTALLED.
2. PARTIAL REFERENCE DESIGNATIONS SHOWN.
   FOR COMPLETE DESIGNATOR ADD 2300
   EXAMPLE R1 IS R2301
3. ALL DIODES ARE CD-61.
4. Q1-Q2&Q4-Q8 ARE 2N3567, Q3 IS EITHER 2N2647, 4JD5E29, OR 4JDX5E738.
5. ALL RESISTORS ARE ±5%, 1/2W.
6. LAST NO USED: C4, CR14, K2, Q8, R24. | NO'S NOT USED: NONE

MODEL	7650	
CHF ENG		
PROJECT		
DESIGN		
CHECK		
DRAFT	B. CHARLES	3/65

76-0723

REL DATE: A

DRAWING SIZE: C

SCHEMATIC
PRINT CONTROL
ASSY 76-6023

CIMRON CORPORATION

76-0723 REV B

PARTS LIST

CIMRON ASSEMBLY: Print Output "A" CIMRON PART NO. 76-6008

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R801	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
SEMICONDUCTOR						
Odd (CR801, CR803, etc., through CR833)		CD-61 DIODE		15318		7-95511
Even (CR802, CR804, etc., through CR834)		CD-62 DIODE		15318		7-95507
MISCELLANEOUS						
K801 - K817		COIL REED DRIVE		15318		70-0511-1
S801 - S817		RELAY REED		95348	MR-306-8	7-38216
J802		CONN RECEPT 50 PIN		02660	57-40500	2-50150
		ETCHED CIRCUIT BOARD		15318		76-7008-1

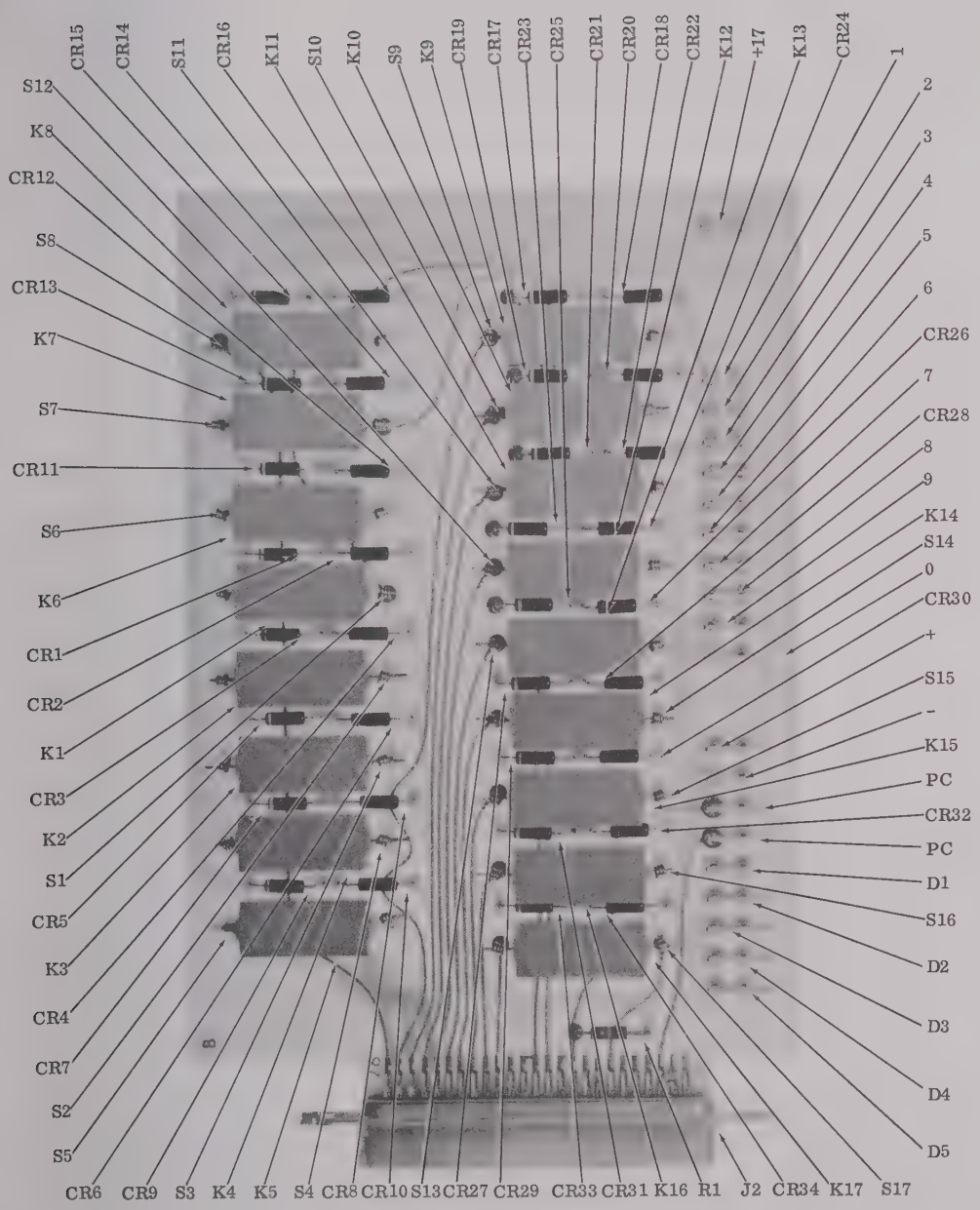
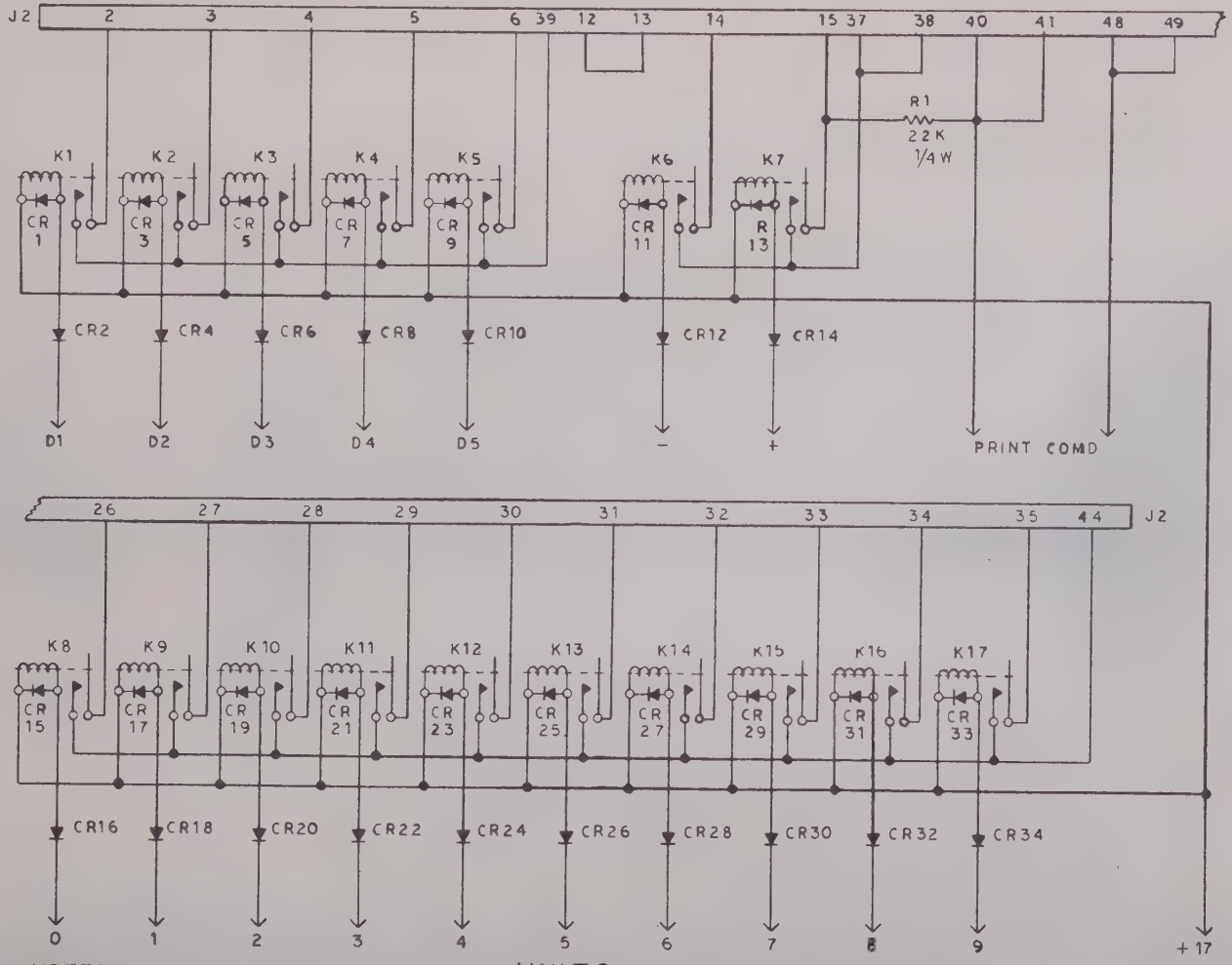


Figure 6-12. Print Output A Assembly.



NOTES◇

1. ALL EVEN NUMBERED DIODES ARE CD-62.
   ALL ODD NUMBERED DIODES ARE CD-61.
2. LAST NO. USED: CR3, K17, R1, J1. | NO'S NOT USED: NONE
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR ADD 800 EXAMPLE CR1 IS CR801.

MODEL	7650
CHF ENG	
PROJECT	
DESIGN	
CHECK	11/7
DRAFT	B. CHARLES 11/30/65

76-0708

REL DATE	
DRAWING SIZE	C

SCHEMATIC
PRINT OUTPUT
"A"
ASSY 76-6008

CIMRON CORPORATION

76-0708 REV

PARTS LIST

CIMRON ASSEMBLY: Print Output "B" CIMRON PART NO. 76-6009

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
SEMICONDUCTOR						
Odd (CR901, CR903, etc., through CR939)		CD-61 DIODE		15318		7-95511
Even (CR902, CR904, etc., through CR940)		CD-62 DIODE		15318		7-95507
MISCELLANEOUS						
K901 - K920		COIL REED DRIVE		15318		70-0511-1
S901 - S920		RELAY REED		95348	MR-306-8	7-38216
J903		CONN RECEPT 50 PIN		02660	57-40500	2-50150
		ETCHED CIRCUIT BOARD		15318		76-7009-1

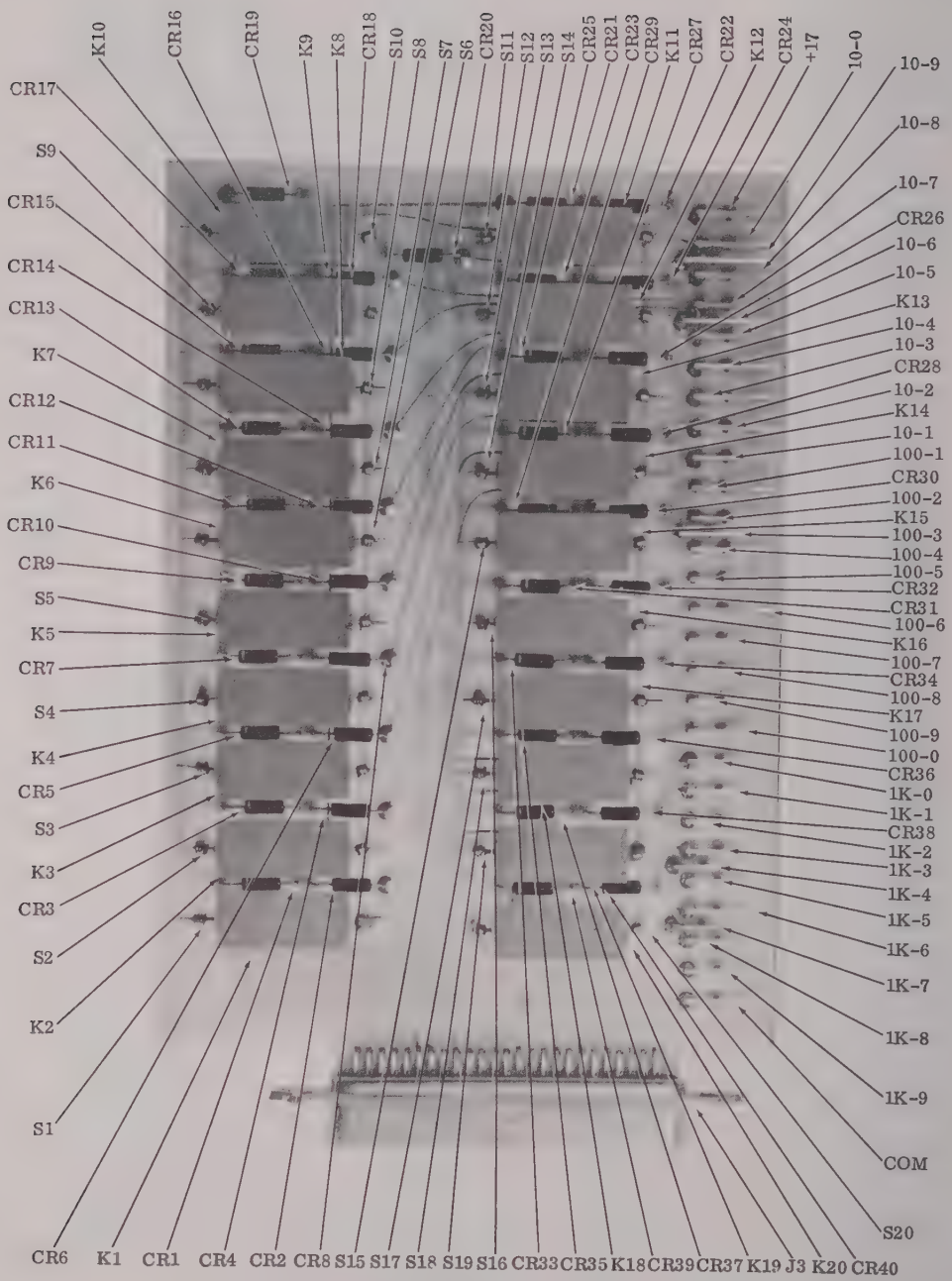
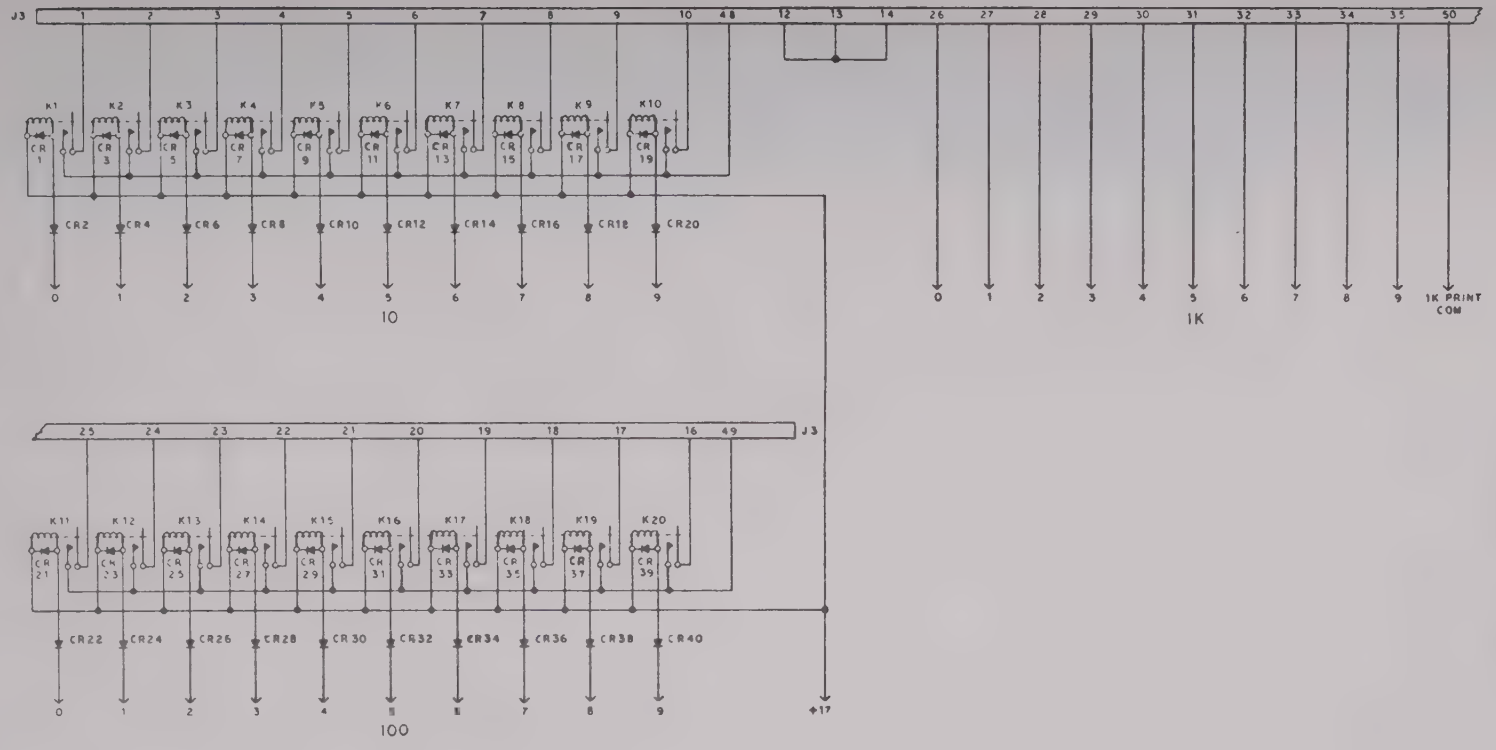


Figure 6-13. Print Output B Assembly.



NOTES ◇

1. ALL EVEN NUMBERED DIODES ARE CD-62. ALL ODD NUMBERED DIODES ARE CD-61.
2. LAST NO USED: CR40, K20 | NO'S NOT USED: NONE
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR ADD 900 EXAMPLE-CR1 IS CR 901.

MODEL 7E50

CW ENG		
PROJECT		
DESIGN		
CHECK		
DRAFT	B. Thomas	8/63

76-0709

REL DATE

DRAWING SIZE D

SCHEMATIC
PRINT OUTPUT
"B"
ASSY 76-6009

CIMRON CORPORATION

76-0709 REV

PARTS LIST

CIMRON ASSEMBLY: Print Output "C" CIMRON PART NO. 76-6010

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
SEMICONDUCTOR						
Odd (CR1001, CR1003, etc., through CR1019)		CD-61 DIODE		15318		7-95511
Even (CR1002, CR1004, etc., through CR1020)		CD-62 DIODE		15318		7-95507
MISCELLANEOUS						
K1001 - K1010		COIL REED DRIVE		15318		70-0511-1
S1001 - S1010		RELAY REED		95348	MR-306-8	7-38216
		ETCHED CIRCUIT BOARD		15318		76-7010-1

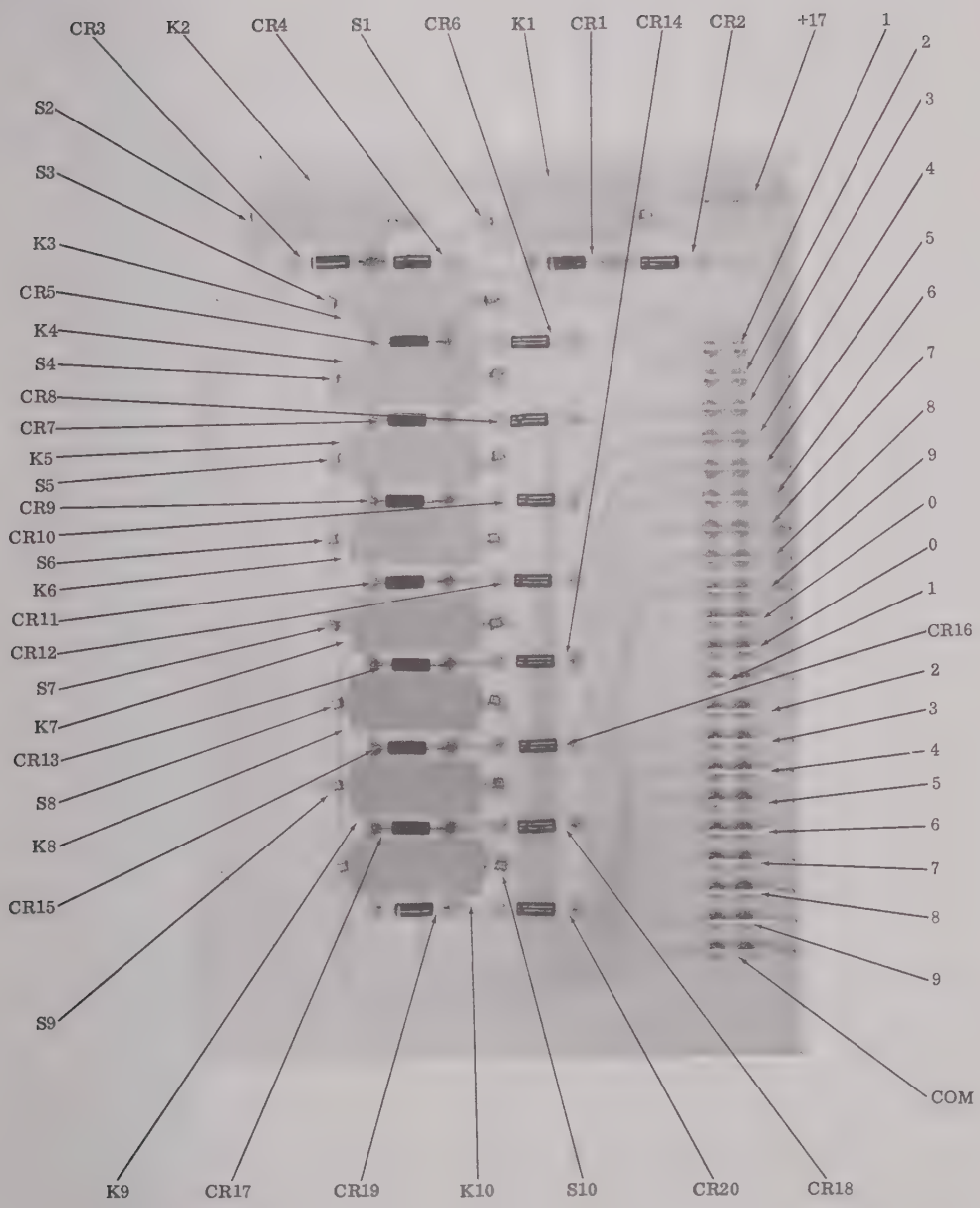
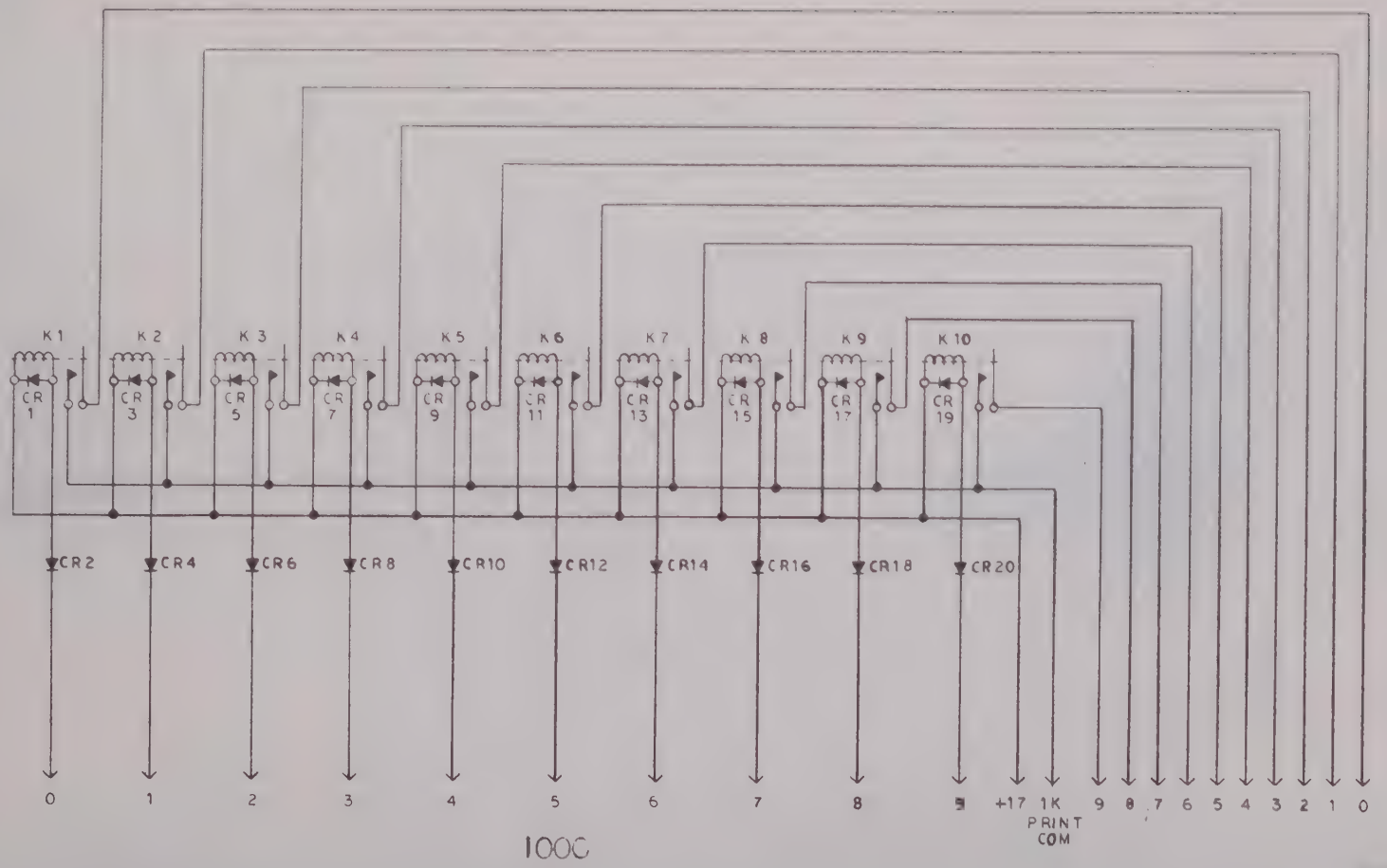


Figure 6-14. Print Output C Assembly.



1000

NOTES◇

1. ALL EVEN NUMBERED DIODES ARE CD 62.
   ALL ODD NUMBERED DIODES ARE CD 61.
2. LAST NO USED: CR20, K10 | NO'S NOT USED: NONE
3. PARTIAL REFERENCE DESGNATIONS SHOWN FOR COMPLETE DESIGNATOR ADD: 4000
   EXAMPLE K1 IS K1001

MODEL	7650
CNF ENG	
PROJECT	
DESIGN	
CHECK	
DRAFT	B. CHARLES 12/9/65

76-0710

REL DATE

DRAWING SIZE C

SCHEMATIC
PRINT OUTPUT
"C"
ASSY 76-6010

CIMRON CORPORATION

76-0710 REV

PARTS LIST

CIMRON ASSEMBLY: Print Output "D" CIMRON PART NO. 76-6007

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
SEMICONDUCTOR						
Odd (CR701, CR703, etc., through CR729)		CD-61 DIODE		15318		7-95511
Even (CR702, CR704, etc., through CR730)		CD-62 DIODE		15318		7-95507
MISCELLANEOUS						
K701 - K715		COIL REED DRIVE		15318		70-0511-1
S701 - S715		RELAY REED		95348	MR-306-8	7-38216
J704		CONN RECEPT 50 PIN		02660	57-40500	2-50150
		ETCHED CIRCUIT BOARD		15318		76-7007-1

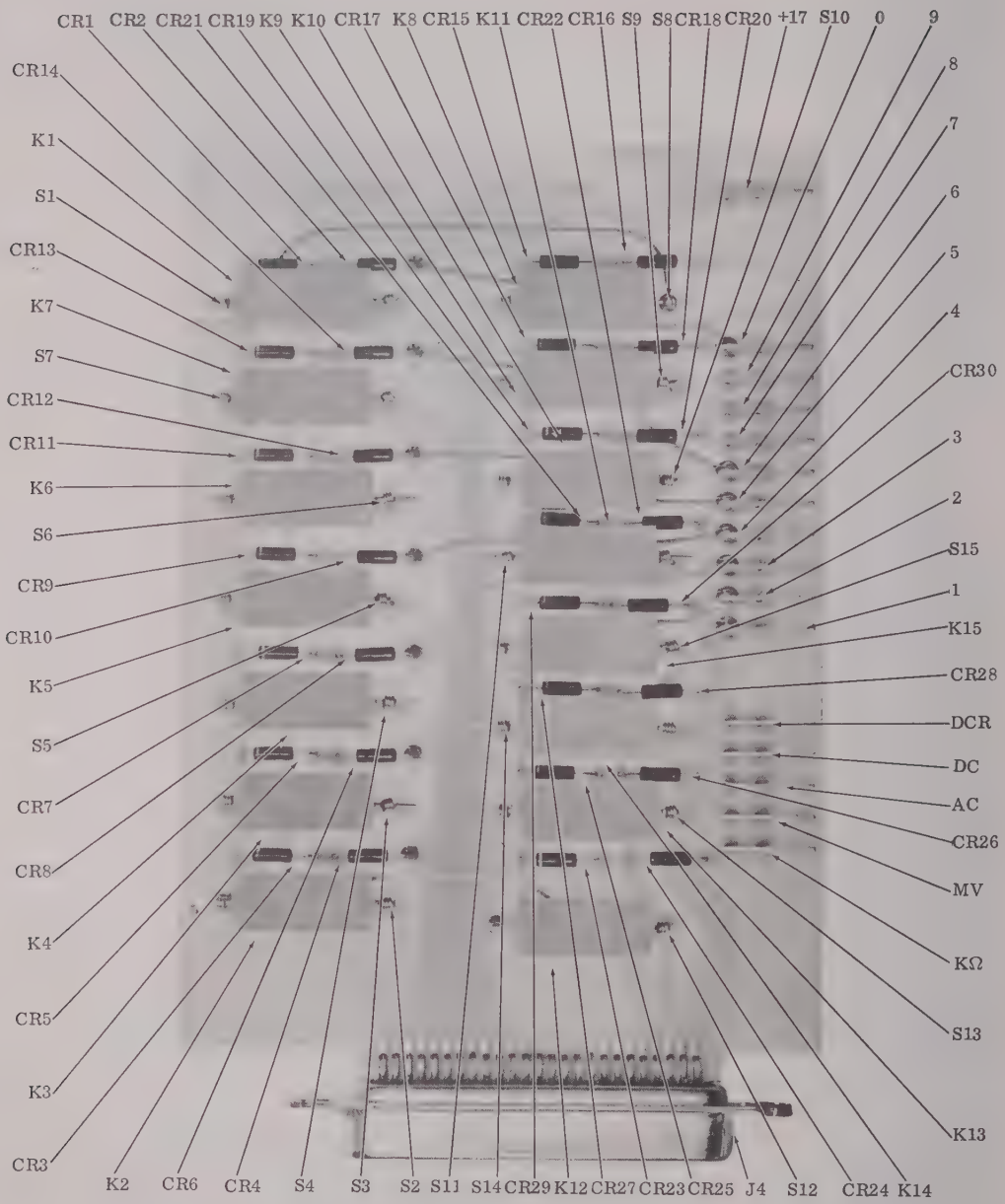
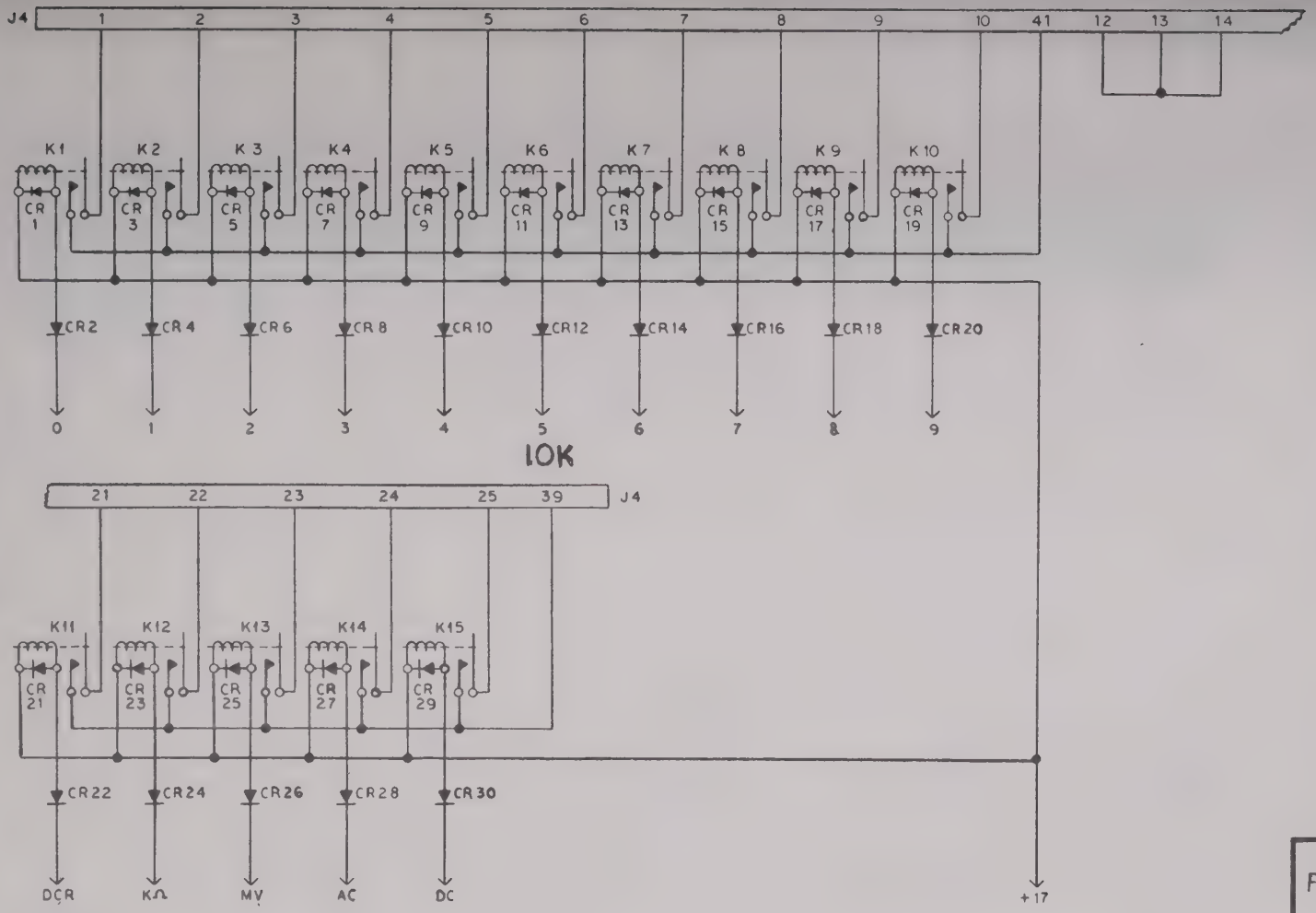


Figure 6-15. Print Output D Assembly.



NOTE ◇

1. ALL EVEN NUMBERED DIODES ARE CD-62
   ALL ODD NUMBERED DIODES ARE CD-61
2. LAST NO USED: CR30, K15 | NO'S NOT USED: NONE
3. PARTIAL REFERENCE DESIGNATIONS SHOWN
   FOR COMPLETE DESIGNATOR ADD 700
   EXAMPLE K1 IS K701

MODEL
7650

CHF ENG		
PROJECT		
DESIGN		
CHECK		
DRAFT	R. K. ASH	12/1/65

76-0707

REL DATE	
DRAWING SIZE	C

SCHEMATIC
PRINT OUTPUT
"D"
ASSY. 76-0707

CIMRON

76-0707 REV

PARTS LIST

CIMRON ASSEMBLY: Power Supply #1 CIMRON PART NO. 76-6021

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
CAPACITOR						
C2101, C2102	450 μf	ELECT	50V	56289	34D457H050HP4	1-57293
C2103	40 μf	ELECT	250V	56289	34D406G250GL4	1-57268
C2104	800 μf	ELECT	30V	56289	34D807H030HP4	1-57292
C2105	20 μf	ELECT	50V	14655	NLW 20-50	1-57256
C2106	10 μf	ELECT	50V	56289	TE 1304	1-57258
RESISTOR						
R2101	75Ω	WW	3W 5%	56289	242E-7505	7-47150
R2102	150 KΩ	COMP	1W 5%	01121	GB-1545	7-44069
R2103	1 KΩ	COMP	1/2W 5%	01121	EB-1025	7-41043
R2104	2.7Ω	COMP	1W 5%	01121	GB-27G5	7-44012
R2105	100Ω	COMP	1/2W 5%	01121	EB-1015	7-41031
R2106	22Ω	COMP	1/2W 5%	01121	EB-2205	7-41023
R2107	1 KΩ	COMP	1/2W 5%	01121	EB-1025	7-41043
SEMICONDUCTOR						
CR2101 - CR2104		SC-2 DIODE		14099	SC-2	7-95502
CR2105 - CR2108		SC-6 DIODE		14099	SC-6	7-95504
CR2109 - CR2112		SC-2 DIODE		14099	SC-2	7-95502
CR2113 - CR2114		CD-61 DIODE		15318		7-95511
CR2115				JEDEC	1N717A	7-95635
CR2116, CR2117		CD-61 DIODE		15318		7-95511
TRANSISTOR						
Q2101				JEDEC	2N697	9-04716
MISCELLANEOUS						
		ETCHED CIRCUIT BOARD		15318		76-7021-1

PARTS LIST

CIMRON ASSEMBLY: Power Supply #2 CIMRON PART NO. 76-6022

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
CAPACITOR						
C2107, C2108	450 μf	ELECT	50V	56289	34D457H050HP4	1-57293
C2109	500 μf	ELECT	3V	56289	TE 1068	1-57239
C2110, C2111	20 μf	ELECT	50V	14655	NLW 20-50	1-57256
RESISTOR						
R2108	2.7Ω	COMP	1W 5%	01121	GB-27G5	7-44012
R2109, R2110	1 KΩ	COMP	1/2W 5%	01121	EB-1025	7-41043
R2111	100Ω	COMP	1/2W 5%	01121	EB-1015	7-41031
R2112	4.7 KΩ	COMP	1/2W 5%	01121	EB-4725	7-41051
R2114	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
SEMICONDUCTOR						
CR2118 - CR2121		SC-2 DIODE		14099	SC-2	7-95502
CR2122, CR2123		CD-61 DIODE		15318		7-95511
CR2124				JEDEC	1N3030B	7-95615
CR2125, CR2126		CD-61 DIODE		15318		7-95511
CR2127, CR2128		SC-2 DIODE		14099	SC-2	7-95502
TRANSISTOR						
Q2102				JEDEC	2N697	9-04716
MISCELLANEOUS						
		ETCHED CIRCUIT BOARD		15318		76-7022-1
		HEATSINK TO-5 CLIP TYPE		02572	TR101	4-65001

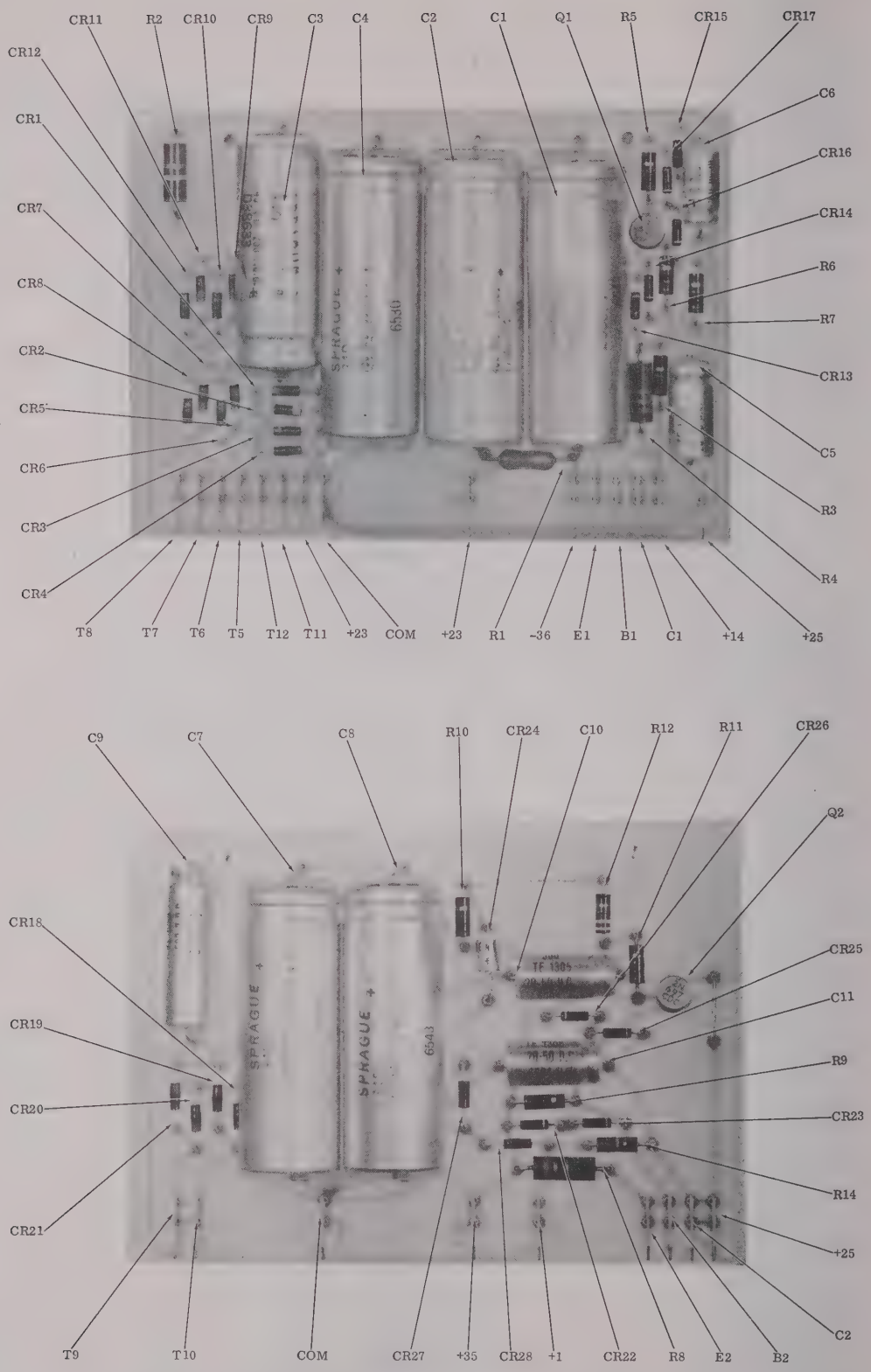
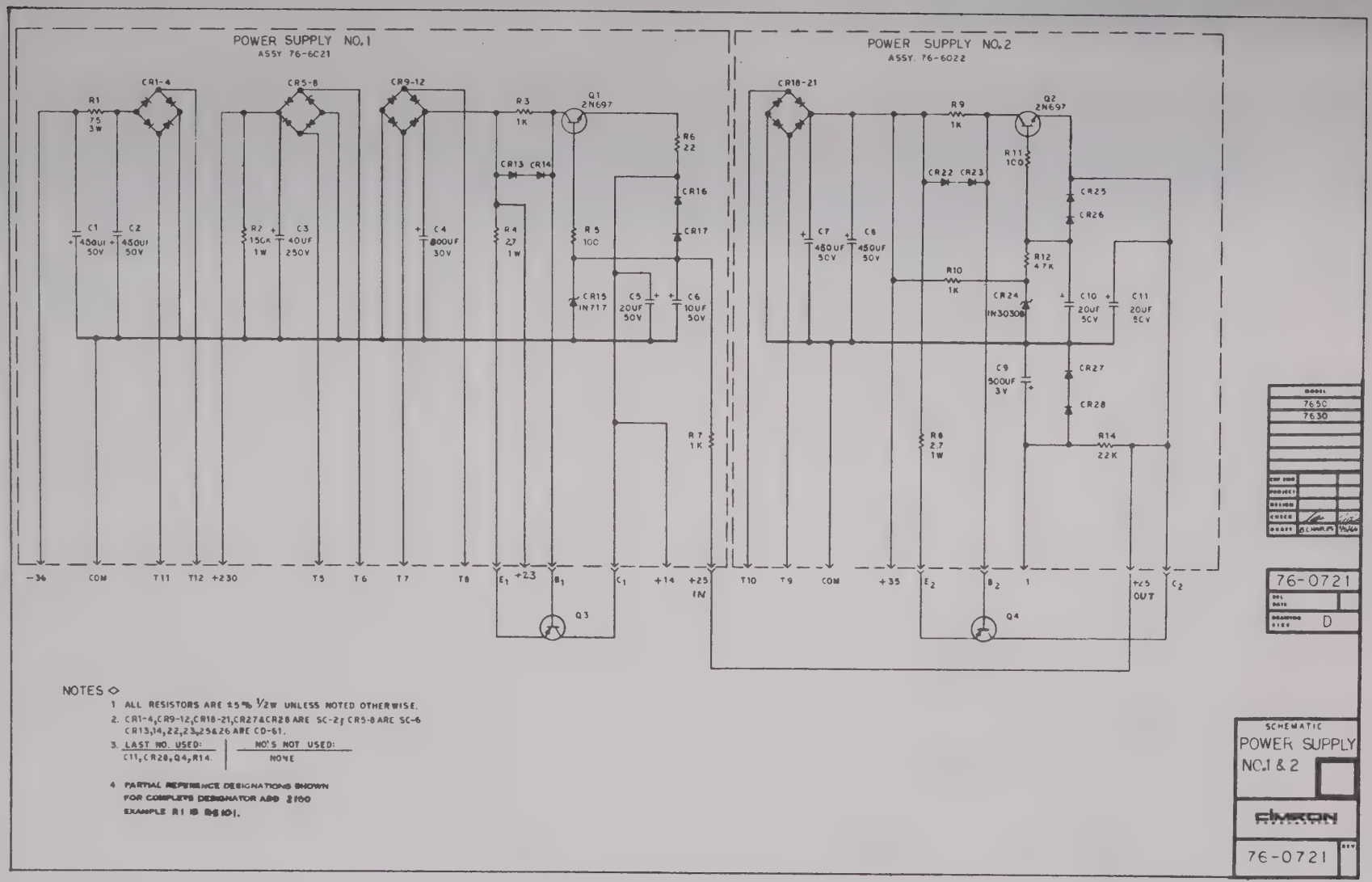


Figure 6-16. Power Supply Assemblies No. 1 and No. 2.



NOTES ◇

1 ALL RESISTORS ARE ±5% 1/2W UNLESS NOTED OTHERWISE.

2. CR1-4, CR9-12, CR18-21, CR27 & CR28 ARE SC-2; CR5-8 ARE SC-6
CR13, 14, 22, 23, 25 & 26 ARE CD-61.

3. LAST NO. USED: C11, CR28, Q4, R14. | NO'S NOT USED: NONE

4 PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR ADD 2100 EXAMPLE R1 IS R2101.

7650
7630

76-0721

D

SCHEMATIC
POWER SUPPLY
NO.1 & 2

CIMTRON

76-0721

PARTS LIST

CIMRON ASSEMBLY: Master — CIMRON PART NO.

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R1 - R5	470 KΩ	COMP	1/2W 5%	01121	EB-4745	7-41075
R6	150 KΩ	COMP	1W 5%	01121	GB-1545	7-44069
R7	47 KΩ	COMP	1/2W 5%	01121	EB-4735	7-41063
R8	100 KΩ	COMP	1/4W 5%	01121	CB-1045	7-41267
R9	60Ω	WW	3W	04387	RS-2B	7-47158
R10	560Ω	COMP	1/2W 5%	01121	EB-5615	7-41040
SEMICONDUCTOR						
CR1 - CR4		CD-61 DIODE		15318		7-95511
CR5 - CR31		CD-62 DIODE		15318		7-95507
CR32, CR33		CD-61 DIODE		15318		7-95511
SWITCH						
S1		ROTARY, 6 POL 5 POS, FUNCTION		15318		8-64055
S2		ROTARY, 8 POL 6 POS, RANGE		15318		8-64061
S3		SLIDE, DPDT		83330	518	8-65006
S4		SLIDE, DPDT		83330	1054	8-65007
S5		SLIDE, SPST, SPRING RETURN		83330	568	8-65008
S6 (R11)	10 KΩ	RESISTOR, VAR COMP, SENSITIVITY SWITCH		15318		60-0506-3
S7		ROCKER, SPDT, POWER		15318		8-65009
S8		SLIDE, 115/230		42190	4633	8-65004
TRANSISTOR						
Q3, Q4		POWER		JEDEC	2N1261	9-04610
MISCELLANEOUS						
C1	1.0 f	POLY STY - CAP 1000V 10%		12406	PD1A105K	1-57361
D1 - D5		LIGHT INDICATOR NEON		03797	1B9A-6488	5-63000
D6 - D8		LAMP		15318		5-47001
DS1 - DS5		ELECTRON TUBE RECT NUMERAL		92379	B-5991	3-41407
DS6		ELECTRON TUBE RECT POLARITY		92379	B-5992	3-41406
F1		FUSE, 3 AG S/B 3/4A		75915	313.750	4-08014
J1		CONNECTOR, INPUT		71468	KPT7A12-8PAY	2-52007
K1		COIL REED DRIVE		15318		70-0511-1
K1		RELAY REED		95348	MR-306-8	7-38216
K2		RELAY 3 PDT		21226	12-BW3-G	7-38215
T1		TRANSFORMER, POWER		15318		76-0500-1
		ANGLE, BEZEL MOUNTING		15318		90-3057-1
		BAR, INSULATING		15318		76-3010-1
		BEZEL		15318		76-3029-1

PARTS LIST

CIMRON ASSEMBLY: Master CIMRON PART NO.

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
MISCELLANEOUS						
		BEZEL		15318		11-3072-1
		BRACKET, RACK MOUNTING		15318		90-3022-3
		BRACKET, SIDE PANEL		15318		90-3058-1
		CORD, AC POWER		15318		2-70000
		COVER CASE		15318		11-3064-1
		COVER MOUNTING BRACKET		15318		11-3047-1
		COVER, SIDE PANEL		15318		11-3071-1
		FUSE HOLDER		75915	342004	4-12000
		GROMMET STRAIN RELIEF		28520	SR-6P-1	4-35000
		GUIDE - ADJUSTMENT		15318		76-3022-1
		INPUT CABLE		15318		90-5004-3
		INPUT SELECTOR CIRCUIT BOARD		15318		76-7065
		INSULATOR		15318		76-2010-1
		KNOB		15318		90-0514-1
		LAMPHOLDER		15318		5-48002
		LENSE - CLEAR		15318		5-61000
		MASTER CIRCUIT BOARD		15318		76-7000-5
		PANEL - REAR		15318		76-2003-1
		PANEL - SIDE		15318		76-2019-1
		PANEL - SUB		15318		76-2005-1
		PLATE - CONNECTOR		15318		76-2004-1
		POLARIZER		15318		76-3001-1
		SHIELD - BOTTOM		15318		76-3013-3
		SHIELD - CENTER		15318		76-3003-1
		SHIELD - LH		15318		76-3004-1
		SHIELD - RH		15318		76-3002-1
		SHIELD - SWITCH		15318		76-3016-1
		SHIELD - TOP		15318		76-3012-1
		SOCKET - ELECTRON TUBE		92379	SK109	8-24002
		STRAP - TOOL HOLDER		15318		70-3005-1
		TOOL - EXTRACTION		15318		70-9500-1
		TRACK - FRONT LH		15318		76-3005-1
		TRACK - CENTER LH		15318		76-3006-1
		TRACK - FRONT RH		15318		76-3007-1
		TRACK - CENTER RH		15318		76-3008-1
		TRACK - REAR		15318		76-2009-1

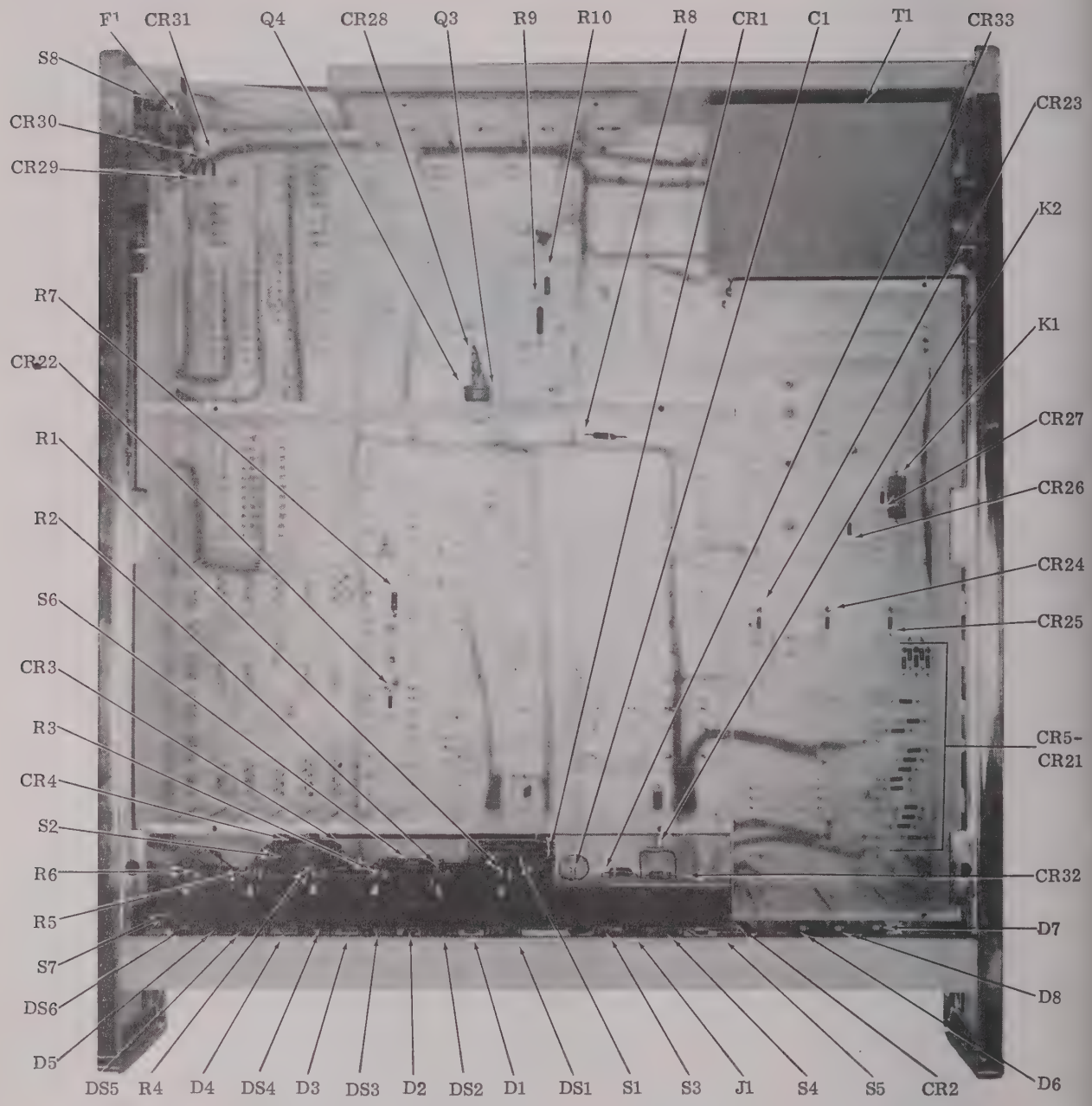


Figure 6-17. Master Assembly.

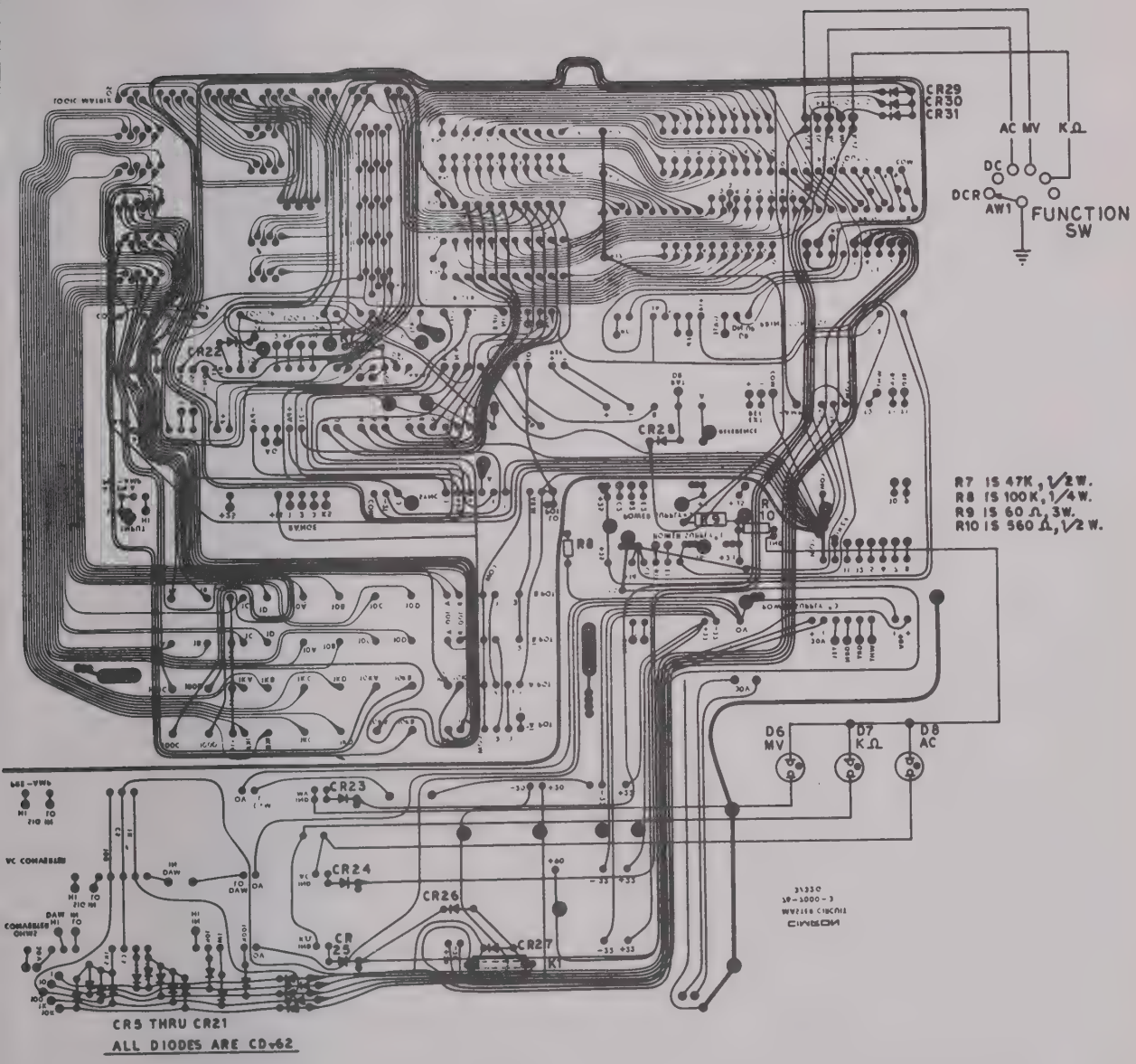
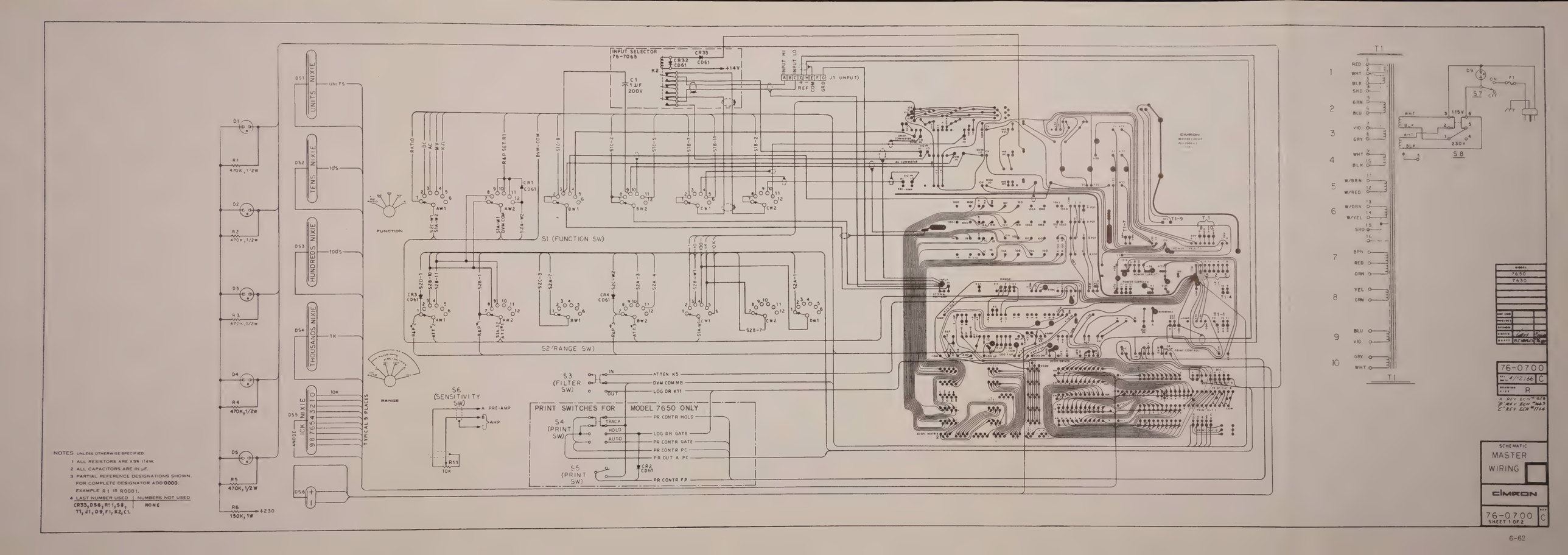


Figure 6-18. Components on Master Assembly.


INPUT SELECTOR 75-7065
J1 (INPUT)
S1 (FUNCTION SW)
S2 (RANGE SW)
S3 (FILTER SW)
S4 (PRINT SW)
S5 (PRINT SW)
S6 (SENSITIVITY SW)
PRINT SWITCHES FOR MODEL 7650 ONLY
UNITS NIXIE
TENS NIXIE
HUNDREDS NIXIE
THOUSANDS NIXIE
TYPICAL 5 PLACES
NOTES UNLESS OTHERWISE SPECIFIED
1 ALL RESISTORS ARE ±5% 1/4W.
2 ALL CAPACITORS ARE IN µF.
3 PARTIAL REFERENCE DESIGNATIONS SHOWN. FOR COMPLETE DESIGNATOR ADD 0000. EXAMPLE R1 IS R0001.
4 LAST NUMBER USED | NUMBERS NOT USED
CR33, DS6, R11, S8, T1, J1, D9, F1, K2, C1. | NONE
76-0700
SCHEMATIC MASTER WIRING
CIMRON
76-0700 SHEET 1 OF 2

SECTION VII

RECOMMENDED SPARE PARTS

The following is a list of the recommended spare parts required to maintain a specific number of instruments at a satisfactory level of performance for one year in an isolated area.

TABLE 7-1.

Recommended Spare Parts.

ASSEMBLY OR PART NAME	ASSEMBLY OR P/N	QUANTITY OF PARTS		
		1 Instrument	5 Instruments	10 Instruments
Attenuator and Pre-Amp	76-6016	1	3	5
Amplifier	76-6013	1	3	5
Logic Driver	76-6012	1	3	5
Logic Matrix	76-6017	1	3	5
Range and Polarity	76-6014	1	3	5
10K Decade	76-6011	1	3	5
Units Through 1K Decade	76-6018	2	6	10
Power Supply 1	76-6021	1	3	5
Power Supply 2	76-6022	1	3	5
A Potentiometer Set	76-6019	1	3	5
B Potentiometer Set	76-6020	1	3	5
Reference and Ratio	76-6024	1	3	5
Print Control, Model 7650 only	76-6023	1	3	5
Print Output A, Model 7650 only	76-6008	1	3	5
Print Output B, Model 7650 only	76-6009	1	3	5
Print Output C, Model 7650 only	76-6010	1	3	5
Print Output D, Model 7650 only	76-6007	1	3	5
AC Converter Plug-in Accessory	6770	1	3	5
DC Preamplifier Plug-in Accessory	6880	1	3	5
Ohms Converter Plug-in Accessory	6990	1	3	5
Power Supply Plug-in Accessory	985	1	3	5
Tool, Extraction	90-9500-1	1	3	5
Fuse, 3AG, S-B, 1/2A	4-08013	5	5	10
Fuse Holder	4-12000	1	3	5
Input Cable	90-5004-3	1	2	3

NOTE

The extension boards recommended below are not a functional part of the instrument. They are designed primarily as an aid in troubleshooting. The extension board is placed between a suspected plug-in board and its mating connector in the instrument. The suspected board is thus raised above the surface of the instrument permitting easy access to components and test points.

TABLE 7-2.

Test and Extension Board Assemblies.

ASSEMBLY OR PART NAME	ASSEMBLY OR P/N	QUANTITY OF PARTS		
		1 Instrument	5 Instruments	10 Instruments
Extension Board 12"	76-9501-1	1	2	4
Extension Board 8"	76-9502-1	1	2	4
Extension Board 5.75"	76-9503-1	1	2	4
Logic Tester Assembly	76-9504-1	1	1	1

SECTION VIII

PLUG-IN ACCESSORIES

GENERAL

There are five plug-in accessories available for use with the Series 7600 digital instrument. They are:

Model 985 Power Supply Plug-In Accessory

Model 6770 AC Converter Plug-In Accessory

Model 6771 AC Converter Plug-In Accessory

Model 6880 DC Preamplifier Plug-In Accessory

Model 6990 Ohms Converter Plug-In Accessory

The Model 985 Power Supply Plug-In Accessory is required as a power source for any or all of the other plug-in accessories.

Provisions are made in the instrument for inserting the power supply plug-in accessory and combination of the other plug-in accessories, as shown in figure 8-1.

SECTION VIII SUBSECTIONS

Information pertaining to calibration and specification validation procedures, theory of operation, maintenance instructions, parts lists, component location, and schematic diagrams for each plug-in accessory are contained in applicable subsections of this section.

The Section VIII subsections and the plug-in accessories to which they apply are:

Section VIII-A	Model 985 Power Supply
Section VIII-B	Models 6770 and 6771 AC Converters
Section VIII-C	Model 6880 DC Preamplifier
Section VIII-D	Model 6990 Ohms Converter

PRELIMINARY INSTRUCTIONS

Prior to performing the operational checkout of the power supply plug-in accessory and the calibration and specification validation procedures for the other plug-in accessories, ensure that:

CAUTION

To avoid damage to the DC Preamplifier and Ohms Converter Plug-In Accessories, do not apply more than 100 VDC or peak AC to the input leads when the instrument is in the millivolt measuring mode and do not apply any voltage to the input leads when the instrument is in the resistance measuring mode.

1. The plug-in accessories are firmly seated in the instrument and have been allowed the same environmental temperature stabilizing time and warmup time required for the instrument, as described in Section IV.

2. The operational checkout, described in Section III, and the calibration and specification validation procedures, described in Section IV, have been performed.

NOTE

The calibration and specification validation procedures for the plug-in accessories must be performed in the order indicated.

WARNING

All adjustments should be made with a non-metallic alignment tool to prevent electrical shock and instrument damage.

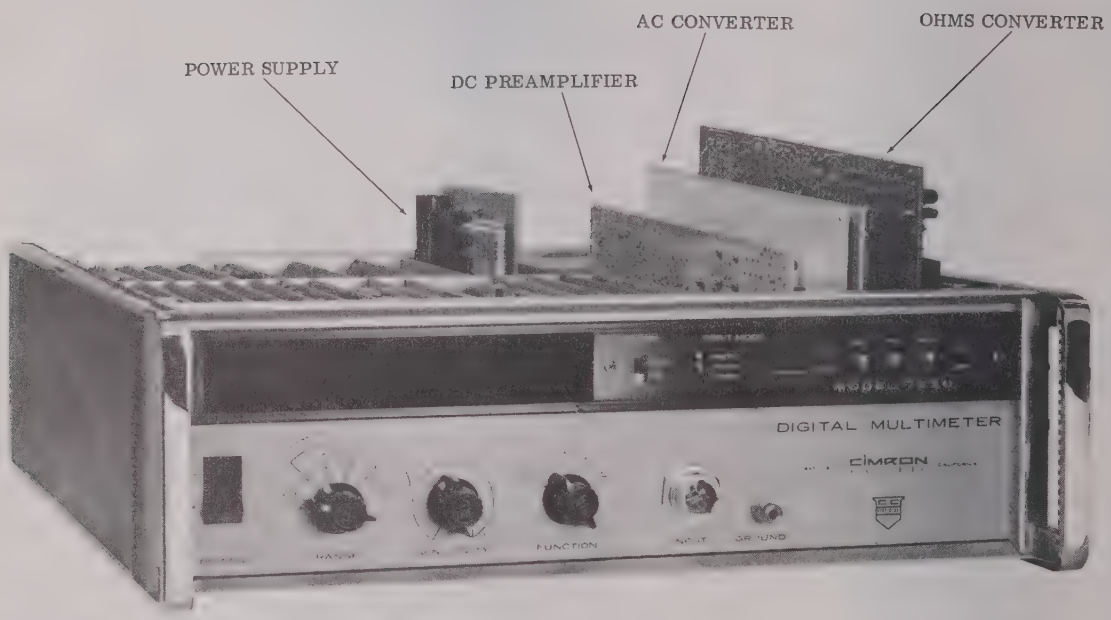


Figure 8-1. Series 7600 Plug-in Accessories.

SECTION VIII-A

MODEL 985 POWER SUPPLY PLUG-IN ACCESSORY

OPERATIONAL CHECKOUT

The power supply is designed to supply DC voltage, with the indicated tolerances and ripple voltage values, as follows:

+22 volts ±10% at 80 milliamperes maximum
Ripple: Less than 10 millivolts peak-to-peak

-22 volts ±10% at 52 milliamperes maximum
Ripple: Less than 10 millivolts peak-to-peak

20 volts ±20% at 35 milliamperes maximum
Ripple: Approximately 3 volts peak-to-peak

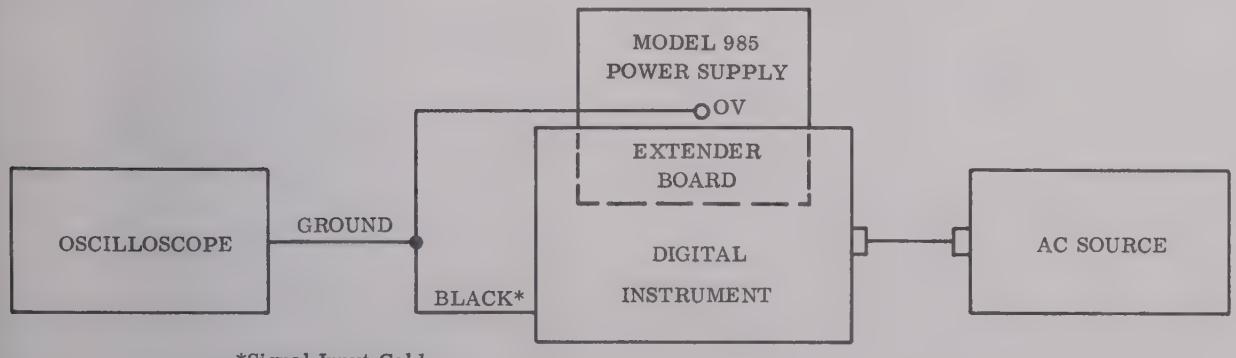
90 volts (-15 volts, +5 volts) at 7 milliamperes maximum
Ripple: Approximately 125 millivolts peak-to-peak

The following special equipment is required in performing the power supply operational checkout:

1. Tektronix Model 502 oscilloscope or equivalent
2. A 60 hertz AC source with a variable output from at least 105 volts to 125 volts rms

Perform the power supply operational checkout as follows:

1. Position the POWER switch to OFF, the FUNCTION switch to AC, MV, or KΩ, depending on which plug-in accessories are available, the RANGE switch to 100, and all other front panel controls to the initial setting (table 4-1).
2. Insert a Cimron Extender Board (Part No. 76-9503-1) in the instrument and mount the power supply plug-in accessory on the extender board.
3. Connect the test setup as indicated in figure 8A-1.
4. Adjust the oscilloscope as follows:
   a. TRIGGERING LEVEL to AUTOMATIC
   b. TRIGGER INPUT to LINE
   c. TIME/CM to 5 mSEC
   d. UPPER BEAM to AC-A
   e. HORIZONTAL DISPLAY to NORMAL
   f. SENSITIVITY control to 1 millivolt per centimeter
   g. 1-to-1 probe into upper beam A
5. Adjust the AC power source for 125 volts output.
6. Connect the oscilloscope 1-to-1 probe and the instrument red signal input lead to the +22



*Signal Input Cable

Figure 8A-1. Power Supply Operational Checkout Test Setup.

terminal of the plug-in power supply (figure 8A-2).

NOTE

When power is first applied to the instrument during the operational checkout, allow a 15 minute warm-up period before proceeding to the next step. For subsequent applications of power, allow a one minute warm-up period.

7. Position the POWER switch to ON.

8. Observe a front panel indication of +22 volts ±10% and an oscilloscope indication of less than 10 millivolts peak-to-peak.

9. Adjust the AC power source for 115 volts output.

10. Repeat step 8.

11. Adjust the AC power source for 105 volts output.

12. Repeat step 8.

13. Position the POWER switch to OFF.

14. Connect the oscilloscope 1-to-1 probe and the instrument red signal input lead to the -22 terminal of the plug-in power supply (figure 8A-2).

15. Position the POWER switch to ON.

16. Observe a front panel indication of +22 volts ±10% and an oscilloscope indication of less than 10 millivolts peak-to-peak.

17. Adjust the AC power source for 115 volts output.

18. Repeat step 16.

19. Adjust the AC power source for 125 volts output.

20. Repeat step 16.

21. Position the POWER switch to OFF.

22. Adjust the oscilloscope sensitivity to 1 volt per centimeter.

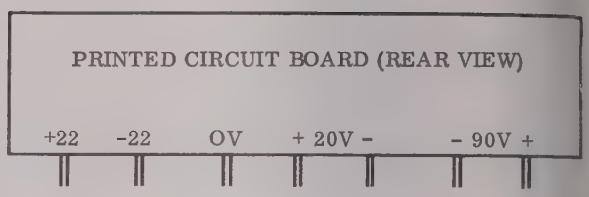


Figure 8A-2. Model 985 Power Supply Plug-In Accessory Output Voltage Terminals.

23. Connect the oscilloscope 1-to-1 probe and the instrument red signal input lead to the -20V terminal of the plug-in power supply (figure 8A-2).

24. Position the POWER switch to ON.

25. Observe a front panel indication of -20 volts ±20% and an oscilloscope indication of approximately 3 volts peak-to-peak.

26. Adjust the AC power source for 115 volts output.

27. Repeat step 25.

28. Adjust the AC power source for 105 volts output.

29. Repeat step 25.

30. Position the POWER switch to OFF.

31. Adjust the oscilloscope sensitivity to 20 millivolts per centimeter.

32. Connect the oscilloscope 1-to-1 probe and the instrument red signal input lead to the +90V terminal of the plug-in power supply (figure 8A-2).

33. Position the POWER switch to ON.

34. Observe a front panel indication of +75 to +95 volts and an oscilloscope indication of approximately 125 millivolts peak-to-peak.

35. Adjust the AC power source for 115 volts output.

36. Repeat step 34.

37. Adjust the AC power source for 125 volts output.

38. Repeat step 34.

39. Position the POWER switch to OFF.

40. Disconnect the test setup.

41. Remove the extender board and insert the plug-in power supply in the instrument.

THEORY OF OPERATION

GENERAL

The power supply provides operating voltages for the other plug-in accessories. All of the plug-in accessories are supplied with regulated plus and minus 22 volts. The DC Preamplifier and the Ohms Converter are also supplied with -20 volts and the AC Converter with +90 volts.

The AC inputs to the power supply full-wave rectifiers are taken from secondary windings of power transformer T1.

CIRCUIT DESCRIPTION (Diagram 76-0704)

The power supply consists of a regulated 22-volt section, a 20-volt section, and a 90-volt section.

Regulated 22-volt Section

The full-wave rectifier consists of diodes CR1 through CR4. The positive output of the rectifier is filtered by capacitors C1 and C5 and is regulated by a series regulating circuit consisting of diode CR13 and transistors Q1, Q2, and Q5. An error voltage is sensed in Q2 by comparison of a portion of the positive output voltage with 12-volt reference diode CR13. The amplified error voltage forms the input to regulating element Q1 and Q5. The +22-volt DC output from the emitter of Q5 develops a controlling voltage of 4.7 volts across diode CR14. The controlling voltage is applied to the junction of the Q2 collector and Q1 base through resistor R10.

The negative output of the rectifier is filtered by capacitors C2 and C6 and is regulated by a series regulating circuit consisting of transistors Q3, Q4, and Q6. An error voltage is sensed in Q3 by comparison of a portion of the +22 volt DC output and the -22 volt DC output with circuit common. The amplified error voltage forms the input to regulating element Q4 and Q6. The -22 volt DC output from the emitter of Q6 develops a controlling voltage of 4.7 volts across diode CR15. The controlling voltage is applied to the junction of the Q3 collector and Q4 base through resistor R11.

20-Volt Section

The full-wave rectifier consists of diodes CR5 through CR8. The output of the rectifier is filtered by capacitors C3 and C7. Resistor R12 is the bleeder resistor.

90-Volt Section

The full-wave rectifier consists of diodes CR9 through CR12. The output of the rectifier is filtered by capacitors C4 and C8. Resistor R13 is the bleeder resistor.

MAINTENANCE

TROUBLESHOOTING

All components of the Power Supply are mounted on a single plug-in circuit board. Troubleshooting is accomplished by replacing the circuit board. When a new circuit board is inserted, the operational checkout for the Power Supply should be made.

REPAIR

A faulty circuit board may be repaired or sent to the factory for repair. When replacing components on a circuit board, extreme care must be taken to prevent damage from excessive heat. A low wattage soldering iron is recommended and, whenever possible, a heat sink should be used. A parts list, an illustrated components location (figure 8A-3), and a schematic diagram of the Power Supply are provided in this section to facilitate repair.

PARTS LIST

CIMRON ASSEMBLY: Power Supply CIMRON PART NO. 76-6004

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
CAPACITOR						
C401, C402	50 μf	ELECT	50V	56289	TE-1307	1-57257
C403	250 μf	ELECT	25V	56289	TVA1208	1-57280
C404	10 μf	ELECT	150V 85°C	14655	NLW 10-150	1-57264
C405, C406	50 μf	ELECT	50V	56289	TE-1307	1-57257
C408	40 μf	ELECT	150V 85°C	56289	TVA1413	1-57265
C409	2.2 μf	TANT	35V 20%	01295	SCM225BP035D4	1-57104
C410	0.01 μf	MET PAP	50V 10%	12406	VX5A103K	1-57323
C411	2.2 μf	TANT	35V 20%	01295	SCM225BP035D4	1-57104
RESISTOR						
R401, R402	47Ω	COMP	1/2W 5%	01121	EB-4705	7-41027
R403	27Ω	COMP	1/2W 5%	01121	EB-2705	7-41024
R404	100Ω	COMP	1/4W 5%	01121	CB-1015	7-41231
R405	1 KΩ	COMP	1/4W 5%	01121	CB-1025	7-41243
R406	3.9 KΩ	COMP	1/4W 5%	01121	CB-3925	7-41250
R407	33Ω	COMP	1/2W 5%	01121	EB-3305	7-41025
R408	100Ω	COMP	1/2W 5%	01121	EB-1015	7-41031
R409 - R411	3.9 KΩ	COMP	1/4W 5%	01121	CB-3925	7-41250
R412	27 KΩ	COMP	1/2W 5%	01121	EB-2735	7-41060
R413	100 KΩ	COMP	1/2W 5%	01121	EB-1045	7-41067
R414, R415	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R416	1 KΩ	COMP	1/4W 5%	01121	CB-1025	7-41243
R417	4.75 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46500
R418	15 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46517
R419	22.1 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46506
R420	21.5 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46527
SEMICONDUCTOR						
CR401 - CR412		DIODE		14099	SC-2	7-95502
CR413		ZENER DIODE		JEDEC	1N719	7-95610
CR414, CR415		ZENER DIODE		JEDEC	1N750	7-95608
CR416		CD-61 DIODE		15318		7-95511
TRANSISTOR						
Q401, Q402		CT-26 or 2N2222		15318		9-04710
Q403, Q404				JEDEC	2N3638	9-04722
Q405				49671	40250	9-04723
Q406				JEDEC	2N3740	9-04802
MISCELLANEOUS						
		ETCHED CIRCUIT BOARD		15318		76-7004-3

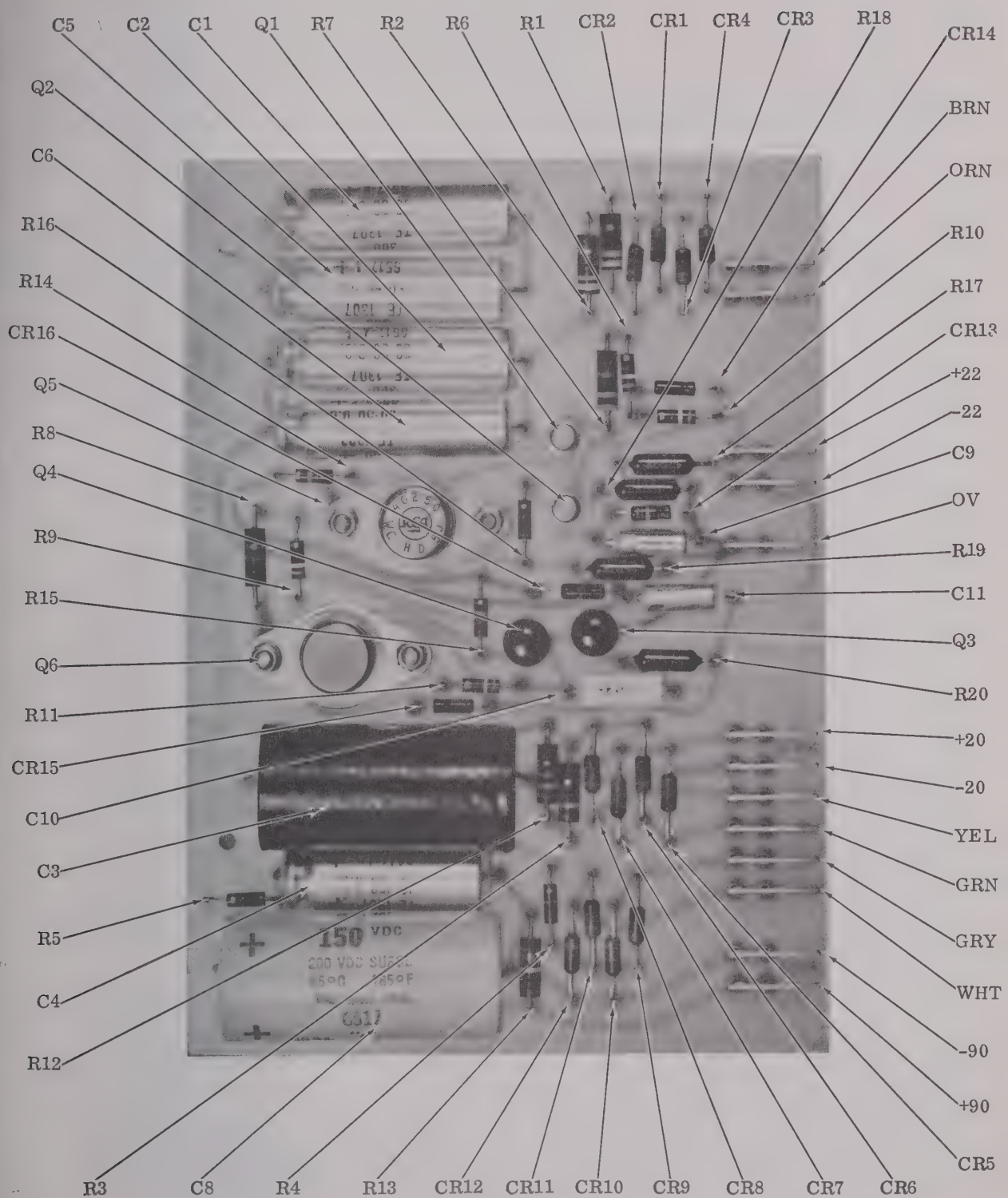
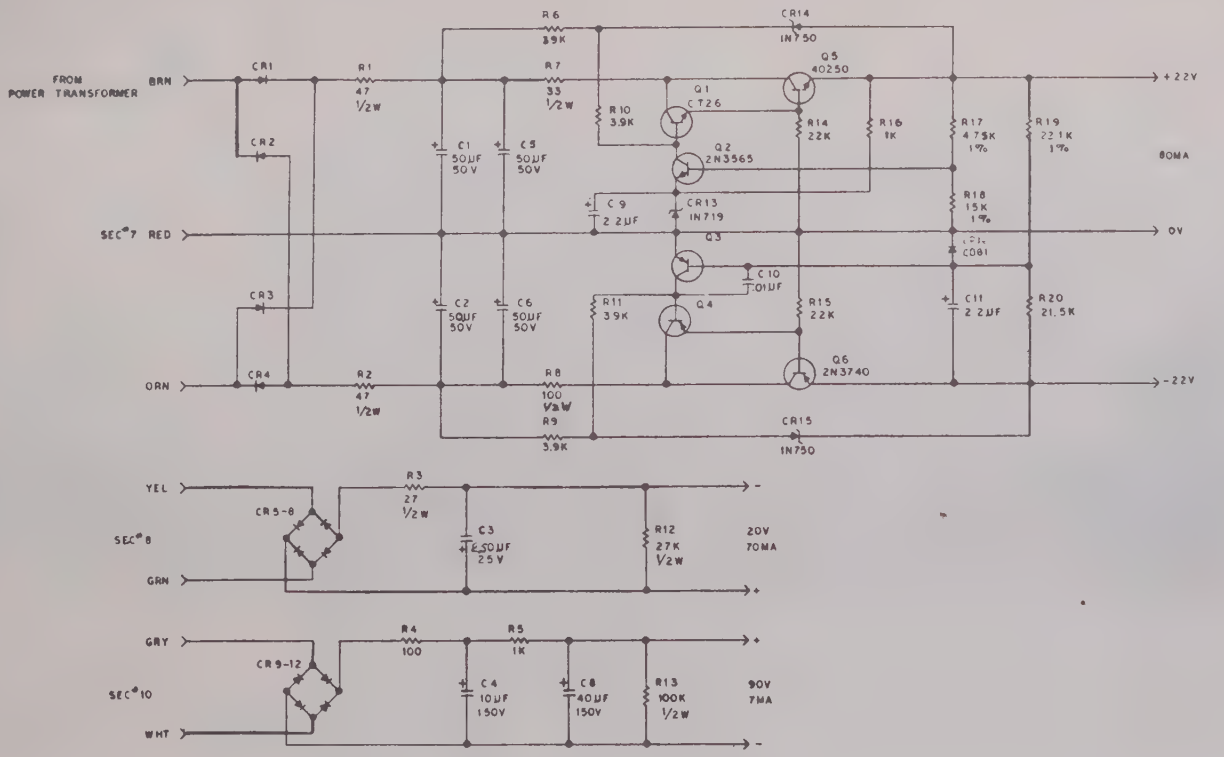


Figure 8A-3. Model 985 Power Supply Plug-in Accessory.



NOTES ◇

1. ALL RESISTOR ARE ±5%, 1/4W UNLESS NOTED OTHERWISE
2. Q3 & Q4 ARE 2N3638.
3. CR1 THRU 12 ARE SC-2.
5. LAST NO USED: C11, CR15, Q6, R20 | NOS NOT USED: ---
6. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR ADD 400 EXAMPLE. R1 IS R 401.

MODEL	
CDR NO.	
PROJECT	
DESIGN	
CHECK	
DRAFT	

76-0704

DES DATE

DRAWING SIZE D

SCHEMATIC
POWER SUPPLY NO. 3
ASSY 76-6004

CIMRON CORPORATION

76-0704 REV

SECTION VIII-B

MODELS 6770 AND 6771 AC CONVERTER PLUG-IN ACCESSORIES

ADJUSTMENT, CALIBRATION, AND SPECIFICATION VALIDATION

GENERAL

The following equipment is required to perform the AC converter adjustment, calibration, and specification validation procedures:

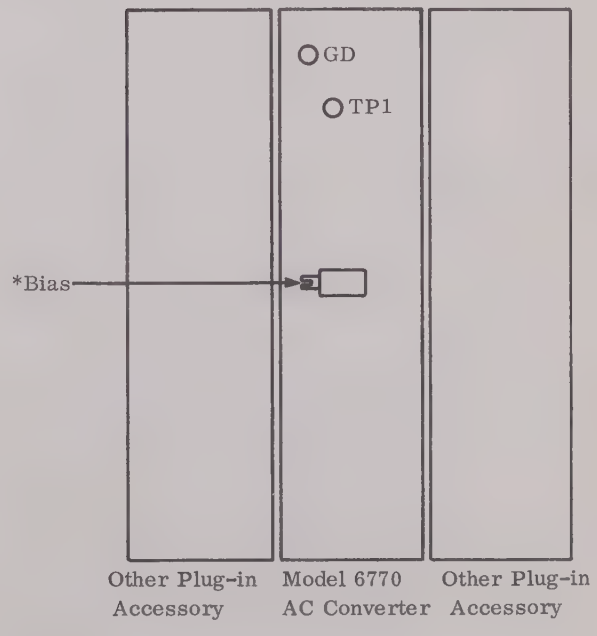
1. Voltohmmeter (VOM), Simpson Model 260 or equivalent
2. DC Power Supply, Fluke Model 332A or equivalent
3. Thermal Transfer Standard, Fluke Model 540B with Model A54-1 Voltage Plug-In Unit or equivalent
4. AC Source, Optimation Model AC104A or equivalent
5. Model 6770 only — Oscilloscope, Tektronix Model 502 or equivalent
6. Resistor, 100 kilohm ±5%

OPERATIONAL ADJUSTMENT

Model 6770 AC Converter

Remove the outer cover and top shield. Perform the adjustment procedure as follows:

1. Position the FUNCTION switch to AC, the FILTER switch to IN, and the other front panel controls to the initial setting (table 4-1).
2. Position the oscilloscope front panel controls to automatic triggering level, 20V/cm sensitivity, and 2 ms/cm time.
3. Connect the oscilloscope between AC Converter test points TP1 and GD (figure 8B-1).
4. Apply 11.500 VAC, 100 Hz, to the INPUT leads.
5. If no clipping appeared on the oscilloscope indication in step 4, increase the INPUT voltage until clipping first occurs.
6. Vary the bias adjustment (figure 8B-1) for equal clipping at top and bottom of the waveform in the oscilloscope indication.



*The word "Bias" does not appear on the printed circuit board.

Figure 8B-1. Model 6770 AC Converter Plug-In Accessory Adjustment (front view).

Model 6771 AC Converter

Connect the red and black input leads together. Perform the adjustment procedure as follows:

1. Position the FUNCTION switch to AC, the FILTER switch to IN, and the other front panel controls to the initial setting (table 4-1).

2. Connect a jumper between TP2 and TP3 on the AC Converter (figure 8B-2).

Figure 8B-2. Model 6771 AC Converter Plug-In Accessory Internal Adjustments (top view).

3. Vary the CONV ZERO adjustment on the AC Converter (figure 8B-2) for a front panel indication of 0.0000.

4. Remove the jumper from TP2 and TP3.

5. Vary the AC ZERO adjustment on the AC Converter (figure 8B-2) for a front panel indication of 0.0000.

TEST EQUIPMENT ACCURACY

The AC converter is an average-reading converter calibrated to the rms equivalent. To accurately calibrate the AC converter, the use of applicable equipment listed on page 8B-1 is mandatory. By use of a thermal transfer standard and a DC voltage standard, accuracy of the AC source can be increased as follows:

1. Connect the test setup as shown in figure 8B-3.

2. Apply a DC voltage to the input of the transfer standard.

3. Adjust the transfer standard null adjustment for a null indication.

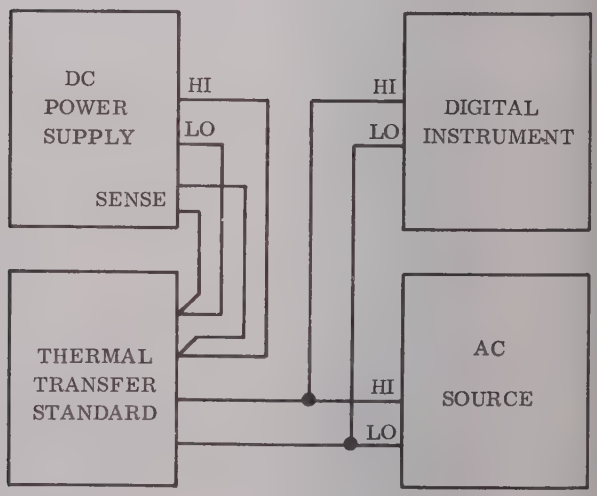


Figure 8B-3. AC Test Setup.

4. Apply an AC voltage at a specific frequency to the transfer standard and adjust the AC voltage until the same null appears.

5. By reading the DC voltage applied, the true rms value of the AC voltage can be determined.

RANGE CALIBRATION

Model 6770 AC Converter

Replace the top shield and perform the range calibration procedure as follows:

1. Position the FUNCTION switch to AC, the FILTER switch to IN, and the other front panel controls to the initial setting (table 4-1).

NOTE

The use of 310 hertz eliminates possible effects of 60 hertz line harmonics.

2. Connect the test setup as shown in figure 8B-3 and adjust the test setup for an AC source output of 9.5000 VAC, 310 Hz.

3. Vary the AC converter 300 ~, 10V adjustment (figure 4-3) for a front panel indication of 9.5000.

4. Adjust the AC source to 20 KHz and vary the AC converter 20 KC, 10V adjustment (figure 4-3) for a front panel indication of 9.5000.

5. Position the RANGE switch to 100 and adjust the test setup for an AC source output of 95.000 VAC, 310 Hz.

6. Vary the AC converter 300 ~, 100V adjustment (figure 4-3) for a front panel indication of 95.000.

7. Adjust the AC source to 20 KHz and vary the AC converter 20 KC, 100V adjustment (figure 4-3) for a front panel indication of 95.000.

8. Position the RANGE switch to 1K and adjust the test setup for an AC source output of 950.00 VAC, 310 Hz.

9. Vary the AC converter 300~, 1000V adjustment (figure 4-3) for a front panel indication of 950.00.

NOTE

The 20 kilohertz, 1000 volt, range attenuator capacitors C16 and C17 (diagram 67-0706) are selected at the factory. If the front panel indication in step 9 is not obtained, capacitor C17 should be changed.

CAUTION

When handling the AC converter, care should be taken not to physically move the large resistor near the end (R1) as this may affect calibration.

10. Adjust the AC source to 20 KHz. The indication should be 950.00 ±100 digits.

Model 6771 AC Converter

Perform the range calibration procedure as follows:

1. Position the FUNCTION switch to AC, the FILTER switch to IN, and the other front panel controls to the initial setting (table 4-1).

CAUTION

Do not apply more than 250 VAC at frequencies between 50 KHz and 100 KHz or more than 500 VAC at frequencies between 20 KHz and 50 KHz. Failure to observe this caution could cause permanent damage to the instrument.

2. Connect the test setup as shown in figure 8B-3 and adjust the test setup for an AC source output of 9.9950 VAC, 100 Hz.

3. Vary the AC Converter 10V LO adjustment (figure 8B-2) for a front panel indication of 9.9950.

4. Position the RANGE switch to 1K and adjust the test setup for an AC source output of 999.50 VAC, 100 Hz.

5. Vary the AC Converter 1KV LO adjustment for a front panel indication of 999.50.

6. Adjust the AC source to 20 KHz and vary the AC Converter 1KV HI adjustment for a front panel indication of 999.50.

7. Position the RANGE switch to 10 and adjust the test setup for an AC source output of 9.9950 VAC, 20 KHz.

8. Vary the AC Converter 10V HI adjustment for a front panel indication of 9.9950.

9. Position the RANGE switch to 100 and adjust the test setup for an AC source output of 99.950 VAC, 100 Hz.

10. Vary the AC Converter 100V LO adjustment for a front panel indication of 99.950.

11. Adjust the AC source to 20 KHz and vary the AC Converter 100V HI adjustment for a front panel indication of 99.950.

SPECIFICATION VALIDATION

Accuracy and Frequency Response

The purpose of the accuracy and frequency response validation is to establish the accuracy with which the accessory operates in conjunction with the instrument when making AC voltage measurements over the frequency range of 30 hertz to 20 kilohertz for Model 6770 or 30 hertz to 100 kilohertz for Model 6771. Validation is accomplished by applying voltages of known accuracy, at various frequencies, to the signal input of the accessory and observing the front panel indication. Perform the accuracy and frequency response validation procedure as follows:

1. Position the FUNCTION switch to AC, the FILTER switch to IN, and the other front panel controls to the initial setting (table 4-1).

2. Connect the test setup as shown in figure 8B-3.

3. Adjust the test setup for an AC source output of 9.5000 VAC.

4. Adjust the AC source successively to the below listed frequencies. Observe that the instrument indicates 9.5000 within 97 digits for steps a through j, within 288 digits for step k, and within 545 digits for step l.

   a. 30 hertz
   b. 100 hertz
   c. 300 hertz
   d. 1 kilohertz
   e. 3 kilohertz
   f. 5 kilohertz
   g. 7 kilohertz
   h. 10 kilohertz
   i. 15 kilohertz
   j. 20 kilohertz
   k. Model 6771 — 50 kilohertz
   l. Model 6771 — 100 kilohertz

5. Position the RANGE switch to 100.

6. Adjust the test setup for an AC source output of 95.000 VAC and repeat step 4 for a front panel indication of 95.000.

7. Position the RANGE switch to 1K.

8. Adjust the test setup for an AC source output of 950.00 VAC and repeat step 4, except for k and l, with a front panel indication of 950.00 within 97 digits.

9. Model 6771 — Adjust the test setup for an AC source output of 500.00 rms VAC. Vary the AC source frequency between 20 KHz and 50 KHz and observe that the front panel indication is 500.00 ±175 digits.

10. Model 6771 — Adjust the test setup for an AC source output of 250.00 rms VAC. Vary the AC source frequency between 50 KHz and 100 KHz and observe that the front panel indication is 250.00 ±175 digits.

Input Resistance

Perform the input resistance validation procedure as follows:

1. Position the FUNCTION switch to AC, the FILTER switch to IN, and the other front panel controls to the initial setting (table 4-1).

2. Measure the resistance between the red and black signal input leads and observe that the resistance is greater than 1 megohm for Model 6770 and greater than 2 megohms for Model 6771.

3. Connect the test setup as indicated in figure 8B-3, with a 100 kilohm resistor in series with the signal input and the AC source.

4. Adjust the test setup for an AC source output of 9.5000 VAC, 100 Hz, and observe that the front panel indication is less than the applied voltage by no more than 10% for Model 6770 and no more than 5% for Model 6771.

5. Position the RANGE switch to 100, adjust the test setup for an AC source output of 95.000 VAC, 100 Hz, and observe that the front panel indication is less than the applied voltage by no more than 10%.

6. Position the RANGE switch to 1K, adjust the test setup for an AC source output of 950.00 VAC, 100 Hz, and observe that the front panel indication is less than the applied voltage by no more than 10%.

AC Floating Input

Perform the AC floating input validation procedure as follows:

1. Position the FUNCTION switch to AC and the other front panel controls to the initial setting (table 4-1).

2. Connect all input leads together.

3. Measure the resistance between the connected leads and the GROUND terminal on the front panel. The VOM should indicate infinity.

4. Model 7650 only — Measure the resistance between the connected leads and the print output connectors on the rear panel. The VOM should indicate infinity while the free VOM lead is slowly moved up and down on the connectors.

THEORY OF OPERATION

GENERAL

The AC Converter Plug-In Accessory:

1. Converts AC input voltages to DC voltages measurable by the basic DC portion of the instrument.

2. Controls the AC function indicator.

In all ranges, with the FUNCTION switch positioned to AC, the input signal is applied to the AC Converter through the normally open contacts of relay K2 in the Input Selector Subassembly.

The AC Converter is an average-reading converter calibrated to the rms equivalent. The AC Converter has three full scale ranges: 9.9999, 99.999, and 999.99 volts AC. In the 99.999 and 999.99 ranges the input voltage is reduced to 1/10 and 1/100 respectively by AC feedback which is 180 degrees out of phase with the input for Model 6770, or by an input attenuator for Model 6771. The AC Converter output is -9.9999 volts full scale on all ranges.

The DC output of the AC Converter is applied through the FUNCTION switch to the Attenuator and Pre-amp Assembly. The output is measured by the basic DC portion of the instrument and indicated on the front panel as AC rms voltage.

The AC function indicator is illuminated through a jumper between two terminals on the AC Converter. When the AC Converter is not inserted into the instrument, the AC function indicator cannot illuminate.

CIRCUIT DESCRIPTION

Model 6770 (Diagram 67-0706)

Signal input voltages from relay K2 in the Input Selector Subassembly are applied across terminals INPUT HI and INPUT LO.

Power is received at terminals +22V, -22V, and +90V from the Model 985 Power Supply Plug-In Accessory and at terminal +CS from Power Supply Assembly #1.

The AC input voltage is amplified by approximately 100 decibels and applied to the junction of rectifier diodes CR11 and CR12. The signal at this point is inverted with respect to the input.

The negative output of the rectifier is filtered and connected through terminal TO DVM HI FUNCTION SW to the FUNCTION switch. The output circuit is completed by AC Converter common which is connected through terminal TO DVM LO FUNCTION SW to the FUNCTION switch.

Restored full-wave AC signals are applied from the junction of resistors R35 and R36 to the range attenuator circuit.

Range commands are received at 1000V RANGE SW and 100V RANGE SW terminals from the front panel RANGE switch.

The overall gain of the AC Converter is established by the range attenuator controlling the amount of feedback applied to the summing junction at the gate of field effect transistor Q1. The closure of relays K1 or K2 increases feedback, thereby reducing the overall gain of the AC Converter by a factor of 10 or 100.

Model 6771 (Diagram 67-0731)

Input voltages are applied across terminals IN HI and IN LO.

Power is received at terminals +22V and -22V from the Model 985 Power Supply Plug-In Accessory and at terminal +CS from Power Supply Assembly #1.

A range command is received at terminal 1KV or 100V. Range commands for the AC Converter are received from the RANGE switch.

The range commands control relays K1 and K2. The closure of relay K1 or K2 reduces the input by 1/100 or 1/10 respectively.

The attenuated input is amplified by approximately 100 decibels and applied to the junction of diodes CR10 and CR11. Variable resistor R7, identified as AC ZERO, adjusts this stage of the AC Converter for zero output with zero input.

The voltage at TP1 is rectified by diodes CR10 and CR11, filtered, amplified by approximately 3 decibels, and applied to terminals OUT HI and 0V. Variable resistor R55, identified as CONV ZERO, adjusts this stage of the AC Converter for zero output with zero input. The output of the AC Converter is directed to the FUNCTION switch.

Function Indicator (Figure 6-18)

The low side of the AC function indicator is connected to terminal AC IND on the signal AC Converter. The adjacent, unmarked terminal is connected to the AC position of the FUNCTION switch. When the AC Converter is inserted in the instrument and the FUNCTION switch is positioned to AC, the AC function indicator is illuminated.

MAINTENANCE

TROUBLESHOOTING

All the components of the AC Converter are mounted on a single plug-in circuit board. Troubleshooting is accomplished by replacing the circuit board. When a new circuit board is inserted, the calibration and specifications validation procedures for the AC Converter should be performed.

REPAIR

A faulty circuit board may be repaired or sent to the factory for repair. When replacing components on a circuit board, extreme care must be taken to prevent damage from excessive heat. A low wattage soldering iron is recommended and, whenever possible, a heat sink should be used. A parts list, an illustrated component location and a schematic diagram of each AC Converter are provided in this section to facilitate repair.

PARTS LIST

CIMRON ASSEMBLY: AC Converter Model 6770 CIMRON PART NO. 67-6006

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
CAPACITOR						
C601	0.47 μf	MET MY	1000V 10%	12406	ZD10A504K	1-57357
C602	2.2 nf	GLASS	500V 10%	07115	CYFM20C222K	1-57601
C603	1 μf	MET PAP	50V 10%	12406	VX5A105K	1-57317
C604, C605	100 μf	TANT	20V 20%	01295	SCM107HP020D4	1-57103
C606	0.22 μf	MET PAP	50V 10%	12406	VX5A224K	1-57319
C607	2.2 μf	TANT	35V 20%	01295	SCM225BP035D4	1-57104
C608	2.2 μf	TANT	20V 10%	56289	150D225X9020A2	1-57108
C609	560 pf	GLASS	500V 10%	07115	CYFM20C561K	1-57600
C610	200 pf	SIL MICA		04062	CM-15-E-201J	1-57474
C611	4.7 μf	TANT	35V 10%	56289	150D475X9035B2	1-57113
C612, C613	5 μf	MET MY	100V	12406	E-1241	1-57304
C614	0.47 μf	MET MY	200V	12406	ZD2A474	1-57307
C615	10 μf	TANT	20V 10%	56289	150D106X9020B2	1-57112
C616, C617	Factory Selected Value					
C618	0.22 μf	POLY STY	100V 10%	12406	PD1A224K	1-57364
C619	0.1 μf	POLY STY	100V 10%	12406	PD1A104K	1-57363
C620	Factory Selected Value					
C621	0.1 μf	POLY STY	100V 10%	12406	PD1A104K	1-57363
C622	0.8-30 pf	VAR	1000V	73899	VC43GW	1-63000
C623	0.5-5 pf	VAR		73899	PT913	1-63004
RESISTOR						
R601	1 MΩ	WW	2W 0.5%	07088	1460-PS-R1	7-47244
R602	6.8 KΩ	COMP	1/4W 5%	01121	CB-6825	7-41253
R603	4.7 KΩ	COMP	1/4W 5%	01121	CB-4725	7-41251
R604	18 KΩ	COMP	1/4W 5%	01121	CB-1835	7-41258
R605	470 KΩ	COMP	1/4W 5%	01121	CB-4745	7-41275
R606	1.8 KΩ	COMP	1/4W 5%	01121	CB-1825	7-41246
R607	18 KΩ	COMP	1/4W 5%	01121	CB-1835	7-41258
R608	56Ω	COMP	1/4W 5%	01121	CB-5605	7-41228
R609	15 KΩ	COMP	1/4W 5%	01121	CB-1535	7-41257
R610	18 KΩ	COMP	1/4W 5%	01121	CB-1835	7-41258
R611	56Ω	COMP	1/4W 5%	01121	CB-5605	7-41228
R612	100 KΩ	COMP	1/4W 5%	01121	CB-1045	7-41267
R613	560Ω	COMP	1/4W 5%	01121	CB-5615	7-41240
R614	2.7 KΩ	COMP	1/4W 5%	01121	CB-2725	7-41248
R615	22Ω	COMP	1/4W 5%	01121	CB-2205	7-41223
R616	560Ω	COMP	1/4W 5%	01121	CB-5615	7-41240
R617	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R618	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R619	56Ω	COMP	1/4W 5%	01121	CB-5605	7-41228
R620	47 KΩ	COMP	1/4W 5%	01121	CB-4735	7-41263
R621	1.8 KΩ	COMP	1/4W 5%	01121	CB-1825	7-41246
R622	6.8 KΩ	COMP	1/4W 5%	01121	CB-6825	7-41253

PARTS LIST

CIMRON ASSEMBLY: AC Converter Model 6770 CIMRON PART NO. 67-6006

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
RESISTOR (Cont'd)						
R623	5.6 KΩ	COMP	1/4W 5%	01121	CB-5625	7-41252
R624	10 KΩ	WW	3W 1%	04387	RS-2B	7-47182
R625	100Ω	COMP	1/4W 5%	01121	CB-1015	7-41231
R626	1 KΩ	COMP	1/4W 5%	01121	CB-1025	7-41243
R627	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R628	180 KΩ	COMP	1/4W 5%	01121	CB-1845	7-41270
R629	390Ω	COMP	1/4W 5%	01121	CB-3915	7-41285
R630	33 KΩ	COMP	1/4W 5%	01121	CB-3335	7-41261
R631	10 KΩ	VAR TRIM WW		80294	275-1-103	7-54198
R632	5.6 KΩ	COMP	1/4W 5%	01121	CB-5625	7-41252
R633	392 KΩ	MET FILM	1/8W 1%	07716	MEA	7-46153
R634	1 KΩ	COMP	1/4W 5%	01121	CB-1025	7-41243
R635, R636	20 KΩ	WW	1/4W 0.1%	07088	1460-PS-R2	7-47245
R637	1.11 KΩ	WW	1/4W 0.1%	07088	1460-PS-R3	7-47246
R638	392 KΩ	MET FILM	1/8W 1%	07716	MEA	7-46153
R639	300Ω	WW	1% 3W	04387	RS-2B	7-47182
R640	200Ω	VAR TRIM WW		17826	176	7-54228
R641	11.4 KΩ	WW	0.5% 5 ppm	07088	1460-PS-R5	7-47248
R642	500Ω	VAR TRIM WW		17826	MODEL 40	7-54236
R643	114 KΩ	WW	0.5% 5 ppm	07088	1460-PS-R4	7-47247
R644	5 KΩ	VAR TRIM WW		17826	MODEL 40	7-54237
R645	75Ω	WW	1% 3W	04387	RS-2B	7-47187
SEMICONDUCTOR						
CR601				JEDEC	1N914	7-85647
CR602		CD-61		15318		7-85511
CR603, CR604				JEDEC	1N720A	7-85629
CR605				JEDEC	1N750	7-85605
CR606				JEDEC	1N712	7-85611
CR607 - CR609		CD-61		15318		7-85511
CR610				JEDEC	1N712	7-85611
CR611, CR612				JEDEC	1N914	7-85647
CR613		CD-61		15318		7-85511
CR614		CD-62		15318		7-85507
CR615		CD-61		15318		7-85511
CR616		CD-62		15318		7-85507
TRANSISTOR						
Q601				JEDEC	2N3686	9-04725
Q602		CT-31 or 2N1131		15318		9-04600
Q603 - Q608				JEDEC	2N3565	9-04725
Q609 - Q611		2N3440		JEDEC		9-04601

PARTS LIST

CIMRON ASSEMBLY: AC Converter Model [illegible] CIMRON PART NO. [illegible]

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
MISCELLANEOUS						
L601, L602		CHOKE 7.5 KH		15818		[illegible]
K601, K602		COIL REED SWITCH		15818		[illegible]
S601, S602		RELAY REED		96346	MR-306-6	[illegible]
		ETCHED CIRCUIT BOARD		15818		[illegible]
		HEAT SINK TO-6 CLIP TYPE		02672	TH101	[illegible]

PARTS LIST

CIMRON ASSEMBLY: AC Converter Model 6771 CIMRON PART NO. 67-6031

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
CAPACITORS						
C3101	0.8-11 pf	VAR	1250V	18736	TP9G	1-63009
C3102	0.5 μf	MET MYLAR	1000V	12406	ZD10A504K	1-57357
C3103	160 pf	GLASS	500V 5%	07115	CYFM10C161J	1-57609
C3104	180 pf	GLASS	500V 5%	07115	CYFM10C181J	1-57608
C3105	1 nf	CER DISC	1000V 10%	71590	DD-102	1-57504
C3106	47 μf	TANT	50V	06751	TSW2K-50-476	1-57116
C3107	Factory Selected Value					
C3108	18000 pf	MICA	500V 5%	04062	DM-30-183J	1-57451
C3109	68 pf	GLASS	500V 5%	07115	CYFM10C680J	1-57610
C3110	0.8-18 pf	VAR	1000V	73899	VC326W	1-63002
C3111	Factory Selected Value					
C3112	0.8-30 pf	VAR	1000V	73899	VC43GW	1-63000
C3113	1600 pf	MICA	500V	04062	CM20E162J	1-57491
C3114	100 pf	SIL MICA	500V 5%	04062	CM-15-E-101J	1-57469
C3115	10 pf	SIL MICA	500V 5%	04062	CM-15-C-100J	1-57462
C3116, C3117	5 pf	SIL MICA	500V 10%	04062	CM-15-C-050J	1-57482
C3118 - C3121	1 μf	POLYSTY	100V	12406	PD1A105K	1-57361
C3122	0.1 μf	POLY-MATCHED PAIR	100V	15318		46-0511
C3123, C3124	4.7 nf	MET MYLAR	200V	12406	ZD2R472K	1-57365
C3125	5 μf	MET MYLAR	100V	12406	E-1241	1-57304
C3126	0.1 μf	POLYSTY - MATCHED PAIR	100V	15318		46-0511
RESISTORS						
R3101	1 MΩ	WW	2W 0.5%	07088	1460-PS-R1	7-47244
R3102	Factory Selected Value					
R3103	33 KΩ	COMP	1/4W 5%	01121	CB-3335	7-41261
R3104	99.8 KΩ	WW	1/4W 0.1%	07088	1368P	7-47223
R3105	20 KΩ	WW	1/4W 0.1%	07088	1460-PS-R2	7-47245
R3106	470Ω	COMP	1/4W 5%	01121	CB-4715	7-41239
R3107	5 KΩ	VAR		97704	1PC-5K	7-54241
R3108	20 KΩ	WW	1/4W 0.1%	07088	1460-PS-R2	7-47245
R3109	99.8 KΩ	WW	1/4W 0.1%	07088	1368P	7-47223
R3110	2550Ω	MET FILM	1/8W 1%	07716	MEA-T0	7-46150
R3111	825Ω	MET FILM	1/8W 1%	07716	MEC-T9	7-46159
R3112	18 KΩ	COMP	1/4W 5%	01121	CB-1835	7-41258
R3113	2550Ω	MET FILM	1/8W 1%	07716	MEA-T0	7-46150
R3114	825Ω	MET FILM	1/8W 1%	07716	MEC-T9	7-46159
R3115	15 KΩ	COMP	1/4W 5%	01121	CB-1535	7-41257
R3116	39 KΩ	COMP	1/4W 5%	01121	CB-3935	7-41262
R3117	2550Ω	MET FILM	1/8W 1%	07716	MEA-T0	7-46150
R3118	560Ω	COMP	1/4W 5%	01121	CB-5615	7-41240
R3119	47Ω	COMP	1/4W 5%	01121	CB-4705	7-41227
R3120	1 KΩ	COMP	1/4W 5%	01121	CB-1025	7-41243
R3121	5 KΩ	WW	1/4W 0.1%	07088	1368P	7-47307
R3122	500Ω	VAR		97704	1PC-500Ω	7-54240

PARTS LIST

CIMRON ASSEMBLY: AC Converter Model 6771 CIMRON PART NO. 67-6031

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
RESISTORS (Cont'd)						
R3123	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R3124	180Ω	COMP	1/4W 5%	01121	CB-1815	7-41234
R3125, R3126	47Ω	COMP	1/4W 5%	01121	CB-4705	7-41227
R3127	100Ω	VAR		97704	1PC-100Ω	7-54238
R3128	Factory Selected Value					
R3129	1 MΩ	WW	1/4W 0.1%	07088	1368P	7-47210
R3130	Factory Selected Value					
R3131	55.4 KΩ	WW	1/4W 0.1%	07088	1368P	7-47305
R3132	Factory Selected Value					
R3133, R3134	10 KΩ	WW	0.1%	05347	305A	7-47174
R3135	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R3136, R3137	1.1 KΩ	WW	3W	04387	TYPE RS-2B	7-47130
R3138 - R3141	47.5 KΩ	WW	1/4W	22045	LR-12	7-47257
R3142	768 KΩ	MET FILM	1/8W 1%	19701	RN60D7683F	7-46197
R3143	2 MΩ	VAR		15318	78PR2M	7-54248
R3144	768 KΩ	MET FILM	1/8W 1%	19701	RN60D7683F	7-46197
R3145, R3146	47.5 KΩ	WW	1/4W	22045	LR-12	7-47257
R3147	178.4 KΩ	WW	1/4W 0.1%	07088	1368P	7-47306
R3148	30.1 KΩ	WW	1/4W	22045	LR-12	7-47260
R3149	820Ω	COMP	1/4W 5%	01121	CB-8215	7-41242
R3150	30.1 KΩ	WW	1/4W	22045	LR-12	7-47260
R3151	820Ω	COMP	1/4W 5%	01121	CB-8215	7-41242
R3152	47.5 KΩ	WW	1/4W	22045	LR-12	7-47257
R3153	1.5 KΩ	COMP	1/4W 5%	01121	CB-1525	7-41245
R3154	178.4 KΩ	WW	1/4W 0.1%	07088	1368P	7-47306
R3155	100 KΩ	VAR		09145	114-104	7-54210
R3156	4.7 KΩ	COMP	1/4W 5%	01121	CB-4725	7-41251
R3157	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
SEMICONDUCTORS						
CR3101 - CR3113		DIODE		JEDEC	1N914	7-95647
CR3114, CR3115		DIODE, ZENER		JEDEC	1N965A	7-95624
CR3116 - CR3118		DIODE		JEDEC	1N914	7-95647
TRANSISTORS						
Q3101		DUAL FET		16170	SU2098	9-04753
Q3102, Q3103		DUAL		JEDEC	2N4043	9-04735
Q3104				JEDEC	2N3565	9-04725
Q3105				JEDEC	2N4121	9-04806
Q3106				JEDEC	2N3565	9-04725
Q3107				JEDEC	2N3642	9-04737
Q3108				JEDEC	2N3644	9-04808
Q3109		DUAL FET		16170	SU2098	9-04753
Q3110				JEDEC	2N3565	9-04725

PARTS LIST

CIMRON ASSEMBLY: AC Converter Model 6771 CIMRON PART NO. 67-6031

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
MISCELLANEOUS						
A3101		AMPLIFIER		16170	805CE	7-96000
K3101, K3102		REED COIL		15318		80-0502-1
K3101, K3102		REED SWITCH		95348	MR-306-8	7-38216
		ETCHED CIRCUIT BOARD		15318		67-7031-3

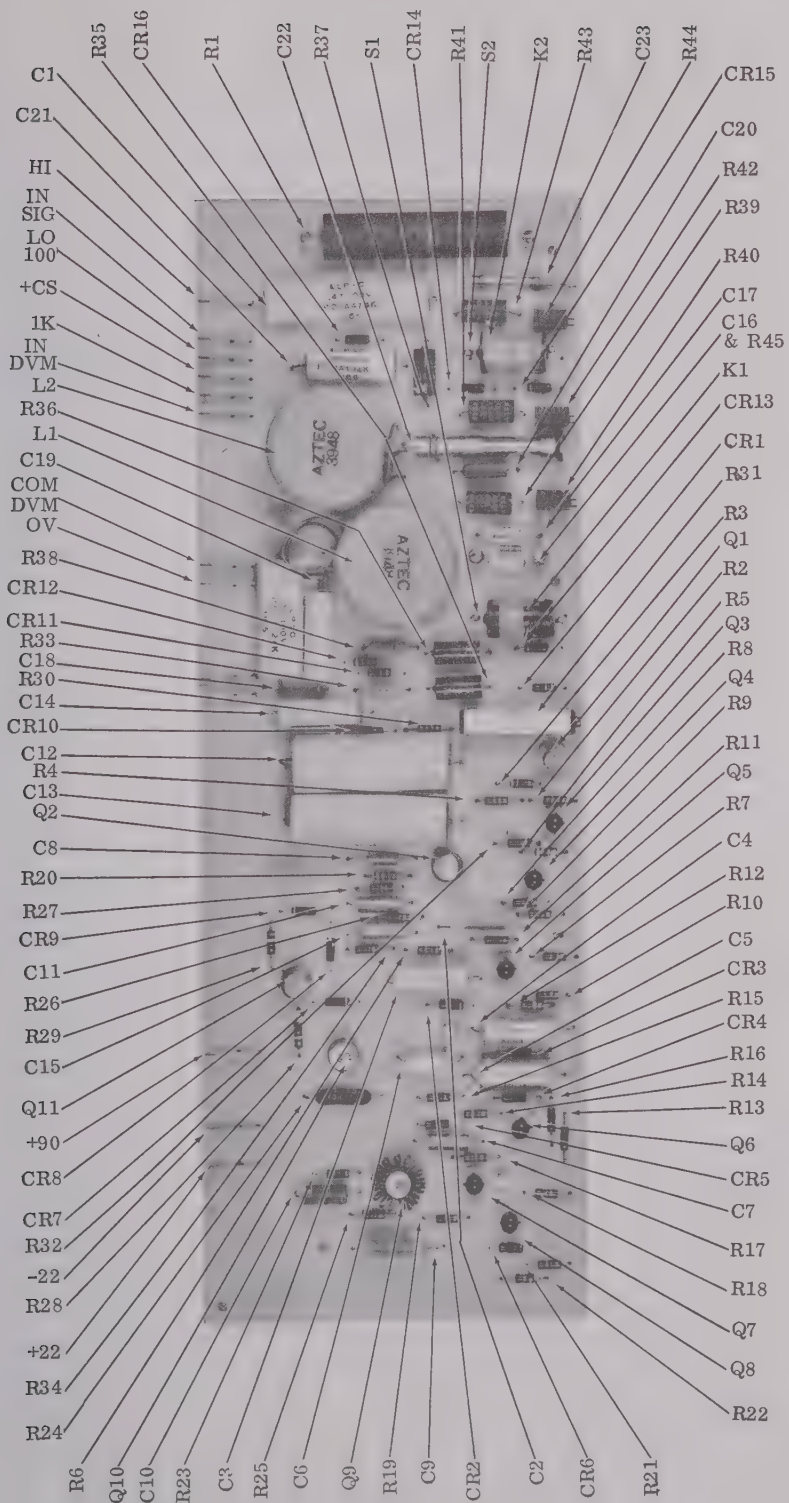


Figure 8B-4. Model 6770 AC Converter Plug-in Accessory.

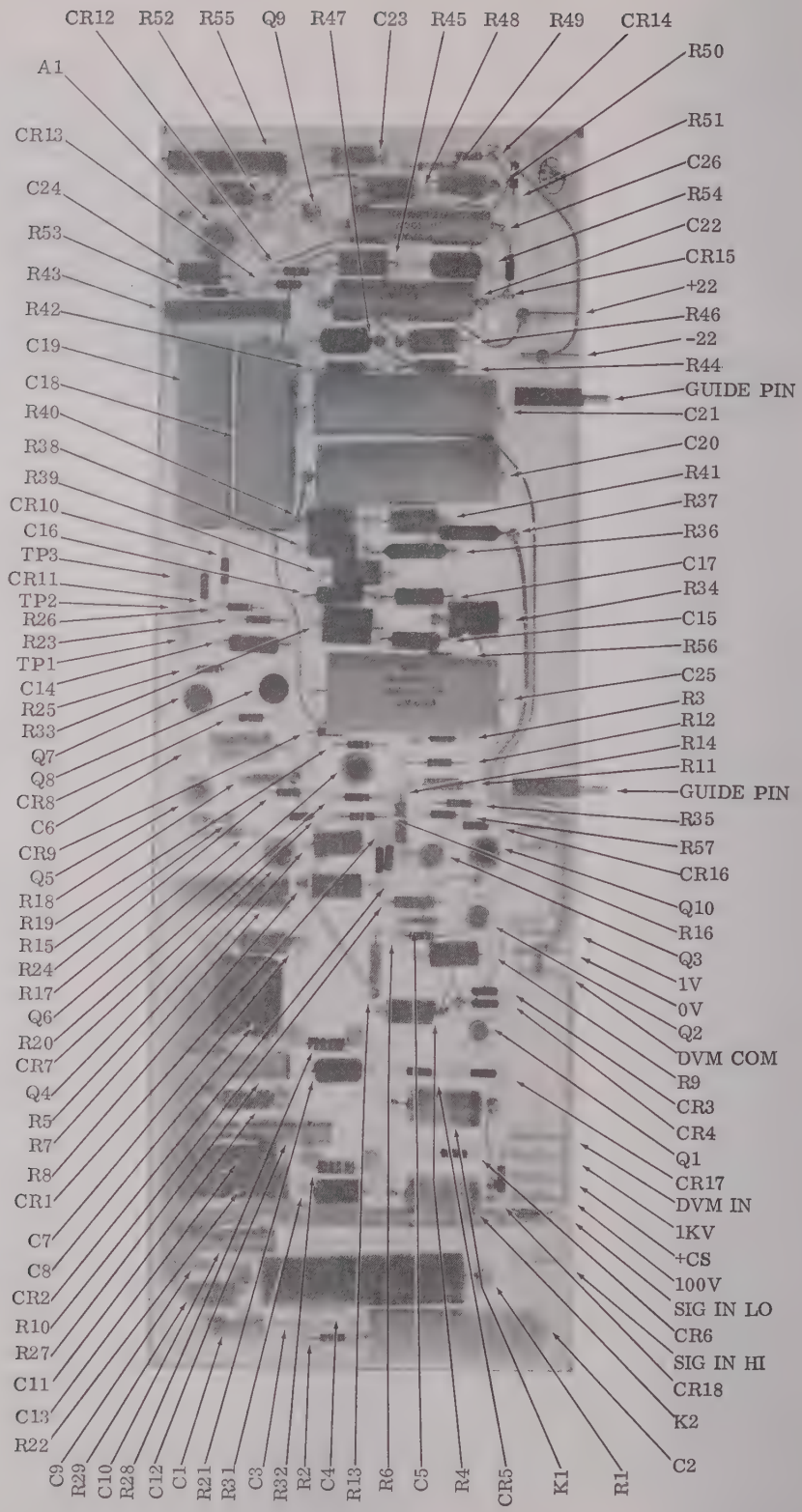
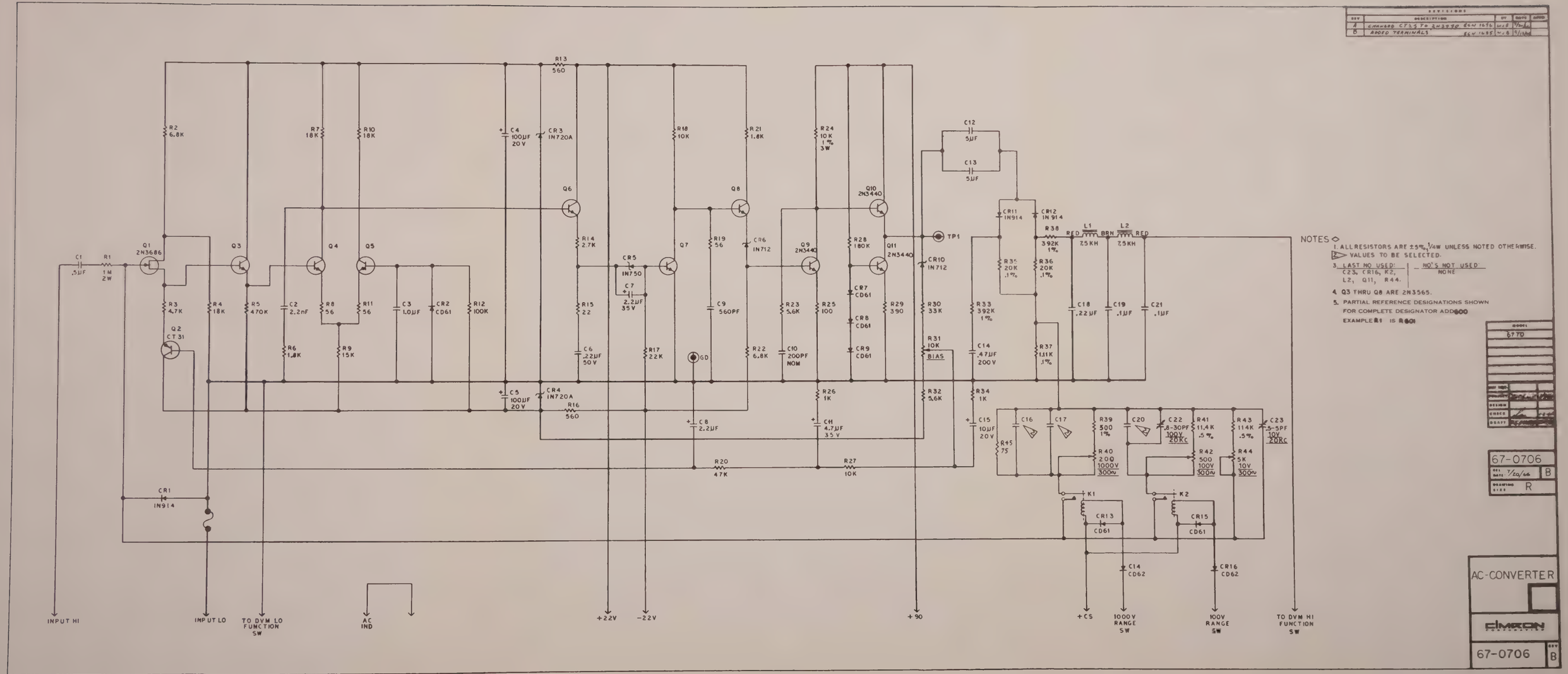
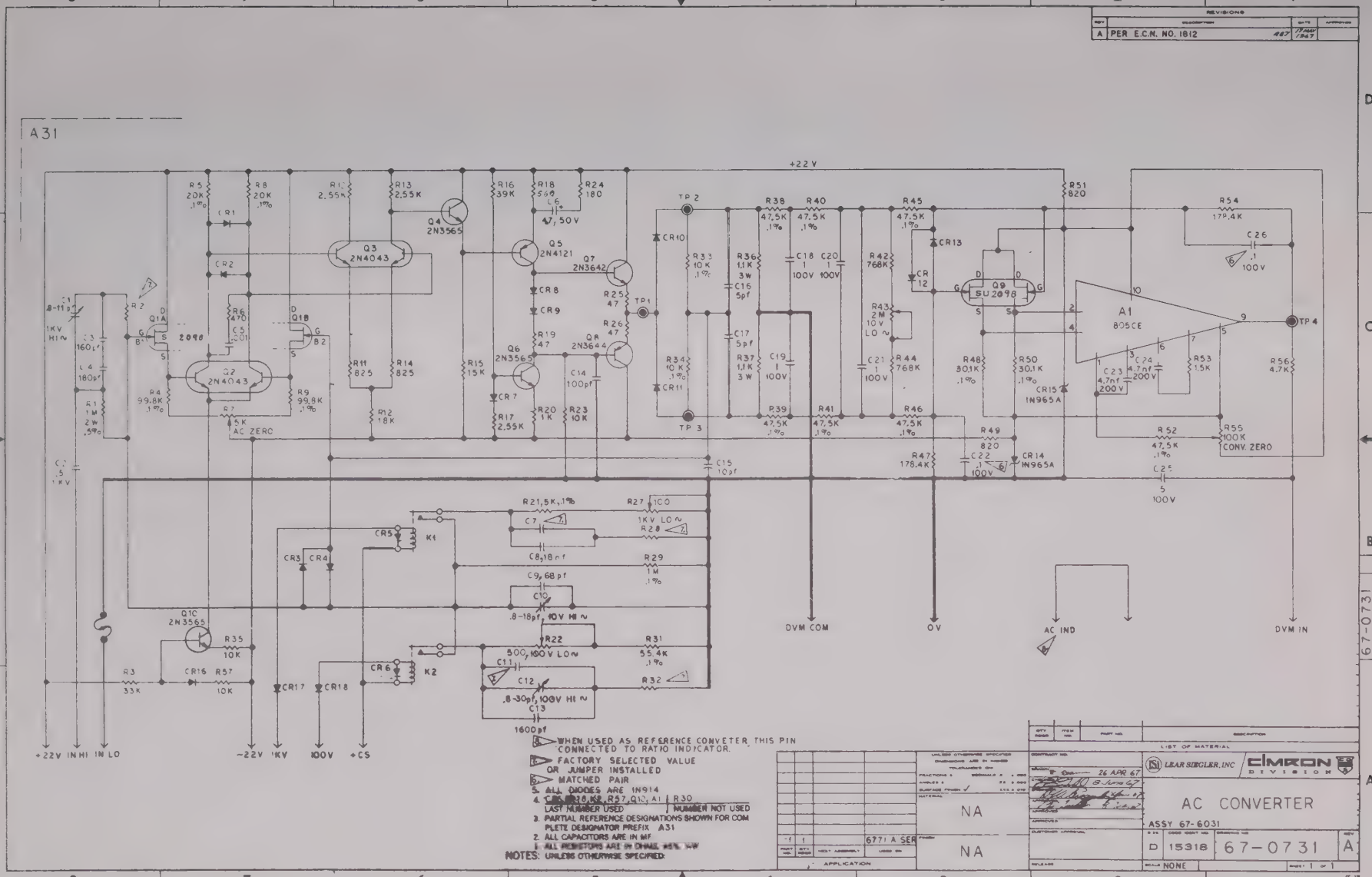


Figure 8B-5. Model 6771 AC Converter Plug-In Accessory.


REVISIONS
REV DESCRIPTION BY DATE APPD
A CHANGED CT33 TO 2N3638 ECN 1695 WLB 9/1/66
B ADDED TERMINALS ECN 1695 WLB 9/13/66
R13 560
R2 6.8K
R7 18K
R10 18K
C4 100µF 20V
CR3 1N720A
R18 10K
R21 1.8K
R24 10K 1% 3W
Q10 2N3440
C12 5µF
C13 5µF
CR11 1N914
CR12 1N914
R38 392K 1%
L1 RED BRN 7.5KH
L2 RED 7.5KH
Q6
Q8
TP1
Q1 2N3686
Q3
Q4
Q5
Q7
Q9 2N3440
Q11 2N3440
C1 .5µF
R1 1M 2W
CR5 1N750
C7 2.2µF 35V
CR10 1N712
R35 20K .1%
R36 20K .1%
R3 4.7K
R4 18K
R5 470K
C2 2.2nF
R8 56
R11 56
C3 1.0µF
CR2 CD61
R12 100K
R14 2.7K
R19 56
CR6 1N712
R23 5.6K
R25 100
R28 180K
CR7 CD61
R29 390
R30 33K
R33 392K 1%
C18 .22µF
C19 .1µF
C21 .1µF
Q2 CT31
R6 1.8K
R9 15K
R15 22
C6 .22µF 50V
R17 22K
GD
R22 6.8K
C10 200PF NOM
CR8 CD61
CR9 CD61
R31 10K BIAS
C14 .47µF 200V
R37 1.11K .1%
C5 100µF 20V
CR4 1N720A
R16 560
C8 2.2µF
C11 4.7µF 35V
R26 1K
R32 5.6K
R34 1K
C15 10µF 20V
C16
C17
R39 500 1%
C20
C22 8-30PF 100V 20KC
R41 11.4K .5%
R43 114K .5%
C23 .5-5PF 10V 20RC
R45 75
R40 200 1000V 300W
R42 500 100V 300W
R44 5K 10V 300W
R20 47K
R27 10K
K1
K2
CR1 IN914
CR13 CD61
CR15 CD61
C14 CD62
CR16 CD62
INPUT HI
INPUT LO
TO DVM LO FUNCTION SW
AC IND
+22V
-22V
+90
+CS
1000V RANGE SW
100V RANGE SW
TO DVM HI FUNCTION SW
NOTES
1. ALL RESISTORS ARE ±5%, ¼W UNLESS NOTED OTHERWISE.
2. VALUES TO BE SELECTED.
3. LAST NO USED: C23, CR16, K2, L2, Q11, R44. | NO'S NOT USED: NONE
4. Q3 THRU Q8 ARE 2N3565.
5. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR ADD 800
EXAMPLE R1 IS R801
MODEL 677D
67-0706 REL DATE 7/20/66 B
DRAWING SIZE R
AC-CONVERTER
CIMRON
67-0706 REV B


A31
+22 V
TP 2
TP 3
TP 4
TP 1
R38 47.5K .1%
R40 47.5K .1%
R45 47.5K .1%
R51 820
R54 178.4K
C26 1 100V
CR10
CR11
CR13
CR12
R33 10K .1%
R34 10K .1%
R36 1.1K 3W
C16 5pf
C17 5pf
R37 1.1K 3W
C18 1 100V
C20 1 100V
C19 1 100V
R42 768K
R43 2M 10V LO ∿
R44 768K
C21 1 100V
Q9 SU2098
A1 805CE
R48 30.1K .1%
R50 30.1K .1%
CR15 1N965A
C23 4.7nf 200V
C24 4.7nf 200V
R53 1.5K
R56 4.7K
R52 47.5K .1%
R55 100K CONV. ZERO
C25 5 100V
R39 47.5K .1%
R41 47.5K .1%
R46 47.5K .1%
R49 820
C22 .1 100V
CR14 1N965A
R47 178.4K
C15 10pf
R5 20K .1%
R8 20K .1%
CR1
CR2
R10 2.55K
R13 2.55K
Q4 2N3565
Q3 2N4043
R16 39K
R18 560
C6 47, 50V
R24 180
Q5 2N4121
Q7 2N3642
CR8
CR9
R25 47
R26 47
Q8 2N3644
R19 47
Q6 2N3565
C14 100pf
CR7
R17 2.55K
R20 1K
R23 10K
C1 8-11pf 1KV HI ∿
Q1A 2098
Q1B 2098
R2
R6 470
C5 .001
C3 160pf
L4 180pf
R1 1M 2W .5%
Q2 2N4043
R4 99.8K .1%
R9 99.8K .1%
R7 5K AC ZERO
R11 825
R14 825
R12 18K
R15 15K
C4 .5 1KV
R21 5K, 1%
R27 100
C7
1KV LO ∿ R28
CR5
K1
CR3
CR4
C8, 18pf
R29 1M .1%
C9, 68pf
C10 .8-18pf, 10V HI ∿
Q1C 2N3565
R35 10K
R22
R31 55.4K .1%
500, 100V LO ∿
C11
C12
.8-30pf, 100V HI ∿
C13 1600pf
R32
R3 33K
CR16
R57 10K
CR17
CR18
CR6
K2
+22V IN HI
IN LO
-22V
1KV
100V
+CS
DVM COM
0V
AC IND
DVM IN
NOTES: UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ±5%, 1/2W
2. ALL CAPACITORS ARE IN MF
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR PREFIX A31
4. C26, R38, K2, R57, Q10, A1 | R30
LAST NUMBER USED | NUMBER NOT USED
5. ALL DIODES ARE 1N914
6. FACTORY SELECTED VALUE OR JUMPER INSTALLED
7. MATCHED PAIR
8. WHEN USED AS REFERENCE CONVETER, THIS PIN CONNECTED TO RATIO INDICATOR.
REVISIONS
A PER E.C.N. NO. 1812
LIST OF MATERIAL
LEAR SIEGLER, INC
CIMRON DIVISION
AC CONVERTER
ASSY 67-6031
D 15318 67-0731 A
SCALE NONE
NA
NA
6771 A SER
APPLICATION
67-0731

SECTION VIII-D

MODEL 6990 OHMS CONVERTER PLUG-IN ACCESSORY

CALIBRATION, AND SPECIFICATION VALIDATION

CALIBRATION

Five resistors are required for range calibration. The resistors should be of the value and tolerance indicated below. If resistors with the indicated values are not available, resistors of lower values, but with the indicated tolerances, may be substituted. The accuracy of the calibration, however, will be proportionately less as the resistance values are decreased.

999 ohms ±0.005%	999 kilohms ±0.01%
9.99 kilohms ±0.005%	9.99 megohms ±0.025%
99.9 kilohms ±0.005%	

Perform the range calibration procedure as follows:

1. Position the FUNCTION switch to KΩ, the RANGE switch to 1, and the other front panel controls to the initial setting (table 4-1).

2. Connect the 999-ohm resistor between the red and black signal input leads and vary the ohms converter 1 KΩ FINE adjustment (figure 4-3) to obtain a front panel indication of .99900. If necessary, vary the 1 KΩ COARSE adjustment (figure 4-3) to bring the 1 KΩ FINE adjustment within range.

3. Position the RANGE switch to 10.

4. Connect the 9.99-kilohm resistor between the red and black signal input leads and vary the ohms converter 10 KΩ adjustment (figure 4-3) to obtain a front panel indication of 9.9900.

5. Position the RANGE switch to 100.

NOTE

When calibrating the 100-kilohm and higher ranges, if the external precision resistors are located in a resistance box, ensure that the resistance box is grounded and that the leads between the resistance box and the red and black signal input leads are kept as short as possible. This precaution reduces the effects of hum pickup which might cause offset or rattling in the instrument.

6. Connect the 99.9-kilohm resistor between the red and black signal input leads and vary the ohms converter 100 KΩ adjustment (figure 4-3) to obtain a front panel indication of 99.900.

7. Position the RANGE switch to 1K.

8. Connect the 999-kilohm resistor between the red and black signal input leads and vary the ohms converter 1 MΩ adjustment (figure 4-3) to obtain a front panel indication of 999.00.

9. Position the RANGE switch to 10K.

10. Connect the 9.99-megohm resistor between the red and black signal input leads and vary the ohms converter 10 MΩ adjustment (figure 4-3) to obtain a front panel indication of 9990.0.

SPECIFICATION VALIDATION

Accuracy

Resistors used for accuracy validation must have values and accuracy equivalent to the resistors used for range calibration.

Perform the accuracy validation procedure as follows:

1. Position the FUNCTION switch to KΩ, the RANGE switch to 1, and the other front panel controls to the initial setting (table 4-1).

2. Connect the 999-ohm resistor between the red and black signal input leads and observe that the front panel indication is .99900 ±.00010 kilohm.

3. Position the RANGE switch to 10.

4. Connect the 9.99-kilohm resistor between the red and black signal input leads and observe that the front panel indication is 9.9900 ±0.0010 kilohms.

5. Position the RANGE switch to 100.

6. Connect the 99.9-kilohm resistor between the red and black signal input leads and observe that the front panel indication is 99.900 ±00.010 kilohms.

7. Position the RANGE switch to 1K.

8. Connect the 999-kilohm resistor between the red and black signal input leads and observe that the front panel indication is 999.00 ±000.20 kilohms.

9. Position the RANGE switch to 10K.

10. Connect the 9.99-megohm resistor between the red and black signal input leads and observe that the front panel indication is 9990.0 ±0005.0 kilohms.

THEORY OF OPERATION

GENERAL

The Model 6990 Ohms Converter Plug-In Accessory:

1. Converts resistance into equivalent DC voltage measurable by the basic DC portion of the instrument.

2. Controls the KΩ function indicator.

In all ranges, with the FUNCTION switch positioned to KΩ, the resistance to be measured is connected through the FUNCTION switch to the Ohms Converter.

The Ohms Converter has five full scale ranges: .99999, 9.9999, 99.999, 999.99, and 9999.9 kilohms. In the .99999 range a current of 10 milliamperes is applied to the resistance to be measured, in the 9.9999 range a current of one milliampere, in the 99.999 range a current of 100 microamperes, in the 999.99 range a current of 10 microamperes, and in the 9999.9 range a current of one microampere. The voltage developed across the resistance is the Ohms Converter output which is +9.9999 volts full scale on all ranges.

The DC output of the Ohms Converter is applied through the FUNCTION switch to the Attenuator and Pre-amp Assembly. The output is measured by the basic DC portion of the instrument and indicated on the front panel as kilohms resistance.

The KΩ function indicator is illuminated through a jumper between two terminals on the Ohms Converter. When the Ohms Converter is not inserted into the instrument, the KΩ function indicator cannot illuminate.

CIRCUIT DESCRIPTION (Diagram 69-0734)

The resistance to be measured is connected across terminals SIGNAL IN LO and SIGNAL IN HI as a feedback resistor between the input and the output of the Ohms Converter.

Power is received at terminals +22V, -22V, +20V, and -20V from the Model 985 Power Supply Plug-In Accessory, at terminal CS from Power Supply Assembly #1, and at terminals 31 VAC from power transformer, T1 on the Master Assembly.

Range commands are received from the RANGE switch at terminals 1KS, 1K, 10KS, 10K, 100K, and 1M.

The -10 volt output of the reference element develops a reference current across resistors in the range attenuator. The range commands open and close relays K1 through K6 in the combinations shown in the table on the diagram to provide the reference current in decaded steps.

The reference current is supplied to the summing junction at terminal 2 of chopper G1. The chopper compares the summing junction voltage and circuit common (zero volts). Any difference is amplified, inverted, and applied through the feedback circuit to the summing junction. Equilibrium is attained when the Ohms Converter output voltage is of opposite polarity to the reference voltage and large enough to

cause a feedback current equal in magnitude to the reference current.

Resistor R16 is the front panel KΩ ZERO adjustment used to compensate for input lead resistance.

The output of the Ohms Converter is applied from terminals DVM IN HI and SIGNAL IN LO to the FUNCTION switch.

Transistors Q2 and Q4 comprise a 450 hertz oscillator which drives chopper G1. The oscillator also drives clamping transistors Q10 and Q11 through Q7.

The low side of the KΩ function indicator is connected to terminal KΩ IND on the Ohms Converter. The adjacent, unmarked terminal is connected to the KΩ position of the FUNCTION switch. When the FUNCTION switch is positioned to KΩ, the KΩ function indicator is illuminated.

MAINTENANCE

TROUBLESHOOTING

All the components of the Ohms Converter are mounted on a single plug-in circuit board. Troubleshooting is accomplished by replacing the circuit board. When a new circuit board is inserted, the calibration and specification validation procedures for the Ohms Converter should be performed.

REPAIR

A faulty circuit board may be repaired or sent to the factory for repair. When replacing components on a circuit board, extreme care must be taken to prevent damage from excessive heat. A low wattage soldering iron is recommended and, whenever possible, a heat sink should be used. A parts list, an illustrated component location (figure 8D-2), and a schematic diagram of the Ohms Converter are provided in this section to facilitate repair.

PARTS LIST

CIMRON ASSEMBLY: Ohms Converter — CIMRON PART NO. 69-6034

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
CAPACITOR						
C3401	1 μf	MET MY	200V	12406	ZD-2130	1-57308
C3402, C3403	0.22 μf	POLY STY	100V	12406	PD1A224K	1-57364
C3404	15 nf	POLY STY	200V	12406	PD2362	1-57310
C3405	560 pf	GLASS	500V 10%	07115	CYFM20C361K	1-57600
C3406	25 μf	ELECT	25V 85°	14655	NLW 25-25	1-57223
C3407	0.15 μf	MET PAP	50V 10%	12406	VX5A154K	1-57320
C3408	100 μf	ELECT	25V 85°	14655	NLW 100-25	1-57253
C3409	25 μf	ELECT	25V 85°	14655	NLW 25-25	1-57223
C3410	0.15 μf	MET PAP	50V 10%	12406	VX5A154K	1-57320
C3411	0.22 μf	MET PAP	50V 10%	12406	VX5A224K	1-57319
C3412	0.47 μf	MET PAP	50V 10%	12406	VX5A474K	1-57318
C3413	300 μf	ELECT	6V 85°	14655	NLW 300-6	1-57243
C3414	10 nf	MET PAP	100V 10%	04062	1DP-1-103	1-57401
C3415	0.22 μf	MET PAP	50V 10%	12406	VX5A224K	1-57319
C3416	300 μf	ELECT	6V 85°	14655	NLW 300-6	1-57243
C3417	100 μf	ELECT	25V 85°	14655	NLW 100-25	1-57253
C3418	50 μf	ELECT	25V 85°	14655	NLW 50-25	1-57228
C3419	100 μf	TANT	20V 20%	01295	SCM107HP020D4	1-57103
C3420	0.22 μf	MET PAP	50V 10%	12406	VX5A224K	1-57319
C3421	100 μf	ELECT	25V 85°	14655	NLW 100-25	1-57253
C3422	22 μf	TANT	35V 20%	01295	SCM226GP035D4	1-57102
C3423	5 μf	MET PAP	100V 20%	12406	VX1A505	1-57313
C3425 - C3427	0.22 μf	MET PAP	50V 10%	12406	VX5A224K	1-57319
C3428	33 nf	MET PAP	100V 10%	04062	1DP-1-333	1-57409
C3429	2.2 nf	CER DISC	1000V 10%	90201	GP-222	1-57502
RESISTOR						
R3401, R3402	Factory Selected Value					
R3403	50Ω	VAR TRIM WW		09145	114-500	7-54219
R3404	10Ω	VAR TRIM WW		09145	114-100	7-54218
R3405	10Ω	WW	3W 1%	04387	RS-2B	7-47153
R3406	50Ω	VAR TRIM WW		09145	114-500	7-54219
R3407	50 KΩ	VAR TRIM WW		09145	114-503	7-54208
R3408	500Ω	VAR TRIM WW	1/4W	80294	275-1-501	7-54206
R3409	5 KΩ	VAR TRIM WW	1/4W	80294	275-1-502	7-54207
R3410	999Ω	WW	0.1%	07088	1368P	7-47250
R3411	9.985 KΩ	WW	0.1%	07088	OB	7-47205
R3412	10 MΩ	MET FILM	2W 0.25%	07716	MEH-T9	7-46121
R3413	100.75 KΩ	WW	0.05%	07088	OB	7-47200
R3414	1.11 MΩ	WW	1/4W 0.1%	07088	EP21	7-47243
R3415	2Ω	WW	3%	04387	RS-1/2	7-47120
R3416	200Ω	VAR TRIM WW		17826	176	7-54223
R3417, R3418	47 KΩ	COMP	1/4W 5%	01121	CB-4735	7-41263
R3419	680 KΩ	COMP	1/4W 5%	01121	CB-6845	7-41277

PARTS LIST

CIMRON ASSEMBLY: Ohms Converter — CIMRON PART NO. 69-6034

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
RESISTOR (Cont'd)						
R3420	1 KΩ	COMP	1/4W 5%	01121	CB-1025	7-41243
R3421	10 MΩ	COMP	1/4W 5%	01121	CB-1065	7-41291
R3422	560Ω	COMP	1/2W 5%	01121	EB-5615	7-41040
R3423	1 MΩ	COMP	1/4W 5%	01121	CB-1055	7-41279
R3424	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R3425	18 KΩ	COMP	1/4W 5%	01121	CB-1835	7-41258
R3426	250 KΩ	COMP VAR TRIM		11237	220-2	7-48805
R3427, R3428	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R3429	12 KΩ	COMP	1/4W 5%	01121	CB-1235	7-41256
R3430	100 KΩ	COMP	1/4W 5%	01121	CB-1045	7-41267
R3431	330Ω	COMP	1/4W 5%	01121	CB-3315	7-41237
R3432	47 KΩ	COMP	1/4W 5%	01121	CB-4735	7-41263
R3433, R3434	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R3435	33 KΩ	COMP	1/4W 5%	01121	CB-3335	7-41261
R3436	560Ω	COMP	1/2W 5%	01121	EB-5615	7-41040
R3437	8.2 KΩ	COMP	1/4W 5%	01121	CB-8225	7-41254
R3438	3.3 KΩ	COMP	1/4W 5%	01121	CB-3325	7-41249
R3439	2.2 KΩ	COMP	1/4W 5%	01121	CB-2225	7-41247
R3440	100 KΩ	COMP	1/4W 5%	01121	CB-1045	7-41267
R3441	5.6 KΩ	COMP	1/4W 5%	01121	CB-5625	7-41252
R3442	1.8 KΩ	COMP	1/4W 5%	01121	CB-1825	7-41246
R3443	2.2 KΩ	COMP	1/4W 5%	01121	CB-2225	7-41247
R3444	18 KΩ	COMP	1/4W 5%	01121	CB-1835	7-41258
R3445	330Ω	COMP	1/4W 5%	01121	CB-3315	7-41237
R3446	5.6 KΩ	COMP	1/4W 5%	01121	CB-5625	7-41252
R3447	100 KΩ	COMP	1/4W 5%	01121	CB-1045	7-41267
R3448, R3449	5.6 KΩ	COMP	1/4W 5%	01121	CB-5625	7-41252
R3450	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R3451	6.8 KΩ	COMP	1/4W 5%	01121	CB-6825	7-41253
R3452	120Ω	COMP	1/4W 5%	01121	CB-1215	7-41232
R3453	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R3454	3.3 KΩ	COMP	1/4W 5%	01121	CB-3325	7-41249
R3455, R3456	6.8 KΩ	COMP	1/4W 5%	01121	CB-6825	7-41253
R3457	3.9 KΩ	COMP	1/4W 5%	01121	CB-3925	7-41250
R3458	27Ω	COMP	1/4W 5%	01121	CB-2705	7-41224
R3459	3.3 KΩ	COMP	1/4W 5%	01121	CB-3325	7-41249
R3460	390Ω	COMP	1/4W 5%	01121	CB-3915	7-41238
R3461, R3462	3.3 KΩ	COMP	1/4W 5%	01121	CB-3325	7-41249
R3463	22 MΩ	COMP	1/4W 5%	01121	CB-2265	7-41295
R3464	120 KΩ	COMP	1/4W 5%	01121	CB-1245	7-41268
R3465	4.7 KΩ	COMP	1/4W 5%	01121	CB-4725	7-41251
R3466	68 KΩ	COMP	1/4W 5%	01121	CB-6835	7-41265
R3467	50 KΩ	VAR TRIM WW		09145	114-503	7-54208
R3468	120 KΩ	COMP	1/4W 5%	01121	CB-1245	7-41268
R3469	4.7 KΩ	COMP	1/4W 5%	01121	CB-4725	7-41251

PARTS LIST

CIMRON ASSEMBLY: Ohms Converter — CIMRON PART NO. 69-6034

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
RESISTOR (Cont'd)						
R3470	22 MΩ	COMP	1/4W 5%	01121	CB-2265	7-41295
R3471	6.8 KΩ	COMP	1/4W 5%	01121	CB-6825	7-41253
R3472	220Ω	COMP	1/4W 5%	01121	CB-2215	7-41235
R3473	5.6 KΩ	COMP	1/4W 5%	01121	CB-5625	7-41252
R3474	6.8 KΩ	COMP	1/4W 5%	01121	CB-6825	7-41253
R3475	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R3476	1 KΩ	COMP	1/4W 5%	01121	CB-1025	7-41243
R3477	3.9 KΩ	COMP	1/4W 5%	01121	CB-3925	7-41250
R3478	470Ω	COMP	1/4W 5%	01121	CB-4715	7-41239
R3479	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R3480	330Ω	COMP	1/4W 5%	01121	CB-3315	7-41237
SEMICONDUCTOR						
CR3401 - CR3404		CD-61 DIODE		15318		7-95511
CR3405		ZENER DIODE		JEDEC	1N722	7-95612
CR3406		CD-61 DIODE		15318		7-95511
CR3407		ZENER DIODE		JEDEC	1N965A	7-95624
TRANSISTOR						
Q3401				JEDEC	2N3686	9-04728
Q3402				JEDEC	2N404A	9-04609
Q3403		CT-26 or 2N2222		15318		9-04710
Q3404				JEDEC	2N404A	9-04609
Q3405		CT-26 or 2N2222		15318		9-04710
Q3406		CT-20 or 2N697		15318		9-04701
Q3407		CT-26 or 2N2222		15318		9-04710
Q3408, Q3409		CT-20 or 2N697		15318		9-04701
Q3410				JEDEC	2N404A	9-04609
Q3411				JEDEC	2N1304	9-04500
Q3412		CT-20 or 2N697		15318		9-04701
Q3413		CT-31 or 2N1131		15318		9-04800
Q3414 - Q3416		CT-26 or 2N2222		15318		9-04710
Q3417, Q3418		CT-20 or 2N697		15318		9-04701
MISCELLANEOUS						
K3401 - K3406		COIL REED DRIVE		15318		70-0511-1
S3401 - S3406		REED RELAY		95348	MR-306-8	7-38216
G3401		CHOPPER		08664	C1417-2	1-92001
		CHOPPER MTG BKT		15318		70-2005
		CHOPPER SOCKET		72825	9721-194	8-24110
T3401		TRANSFORMER DEMOD		00348	MT18FB	9-01001
F3401 (PLUS SPARE)		FUSE MICROFUSE 1/32 A		03614	TYPE GMW	4-09003
		VOLTAGE REFERENCE STANDARD		15318		69-0508-1
		ETCHED CIRCUIT BOARD		15318		69-7034-3

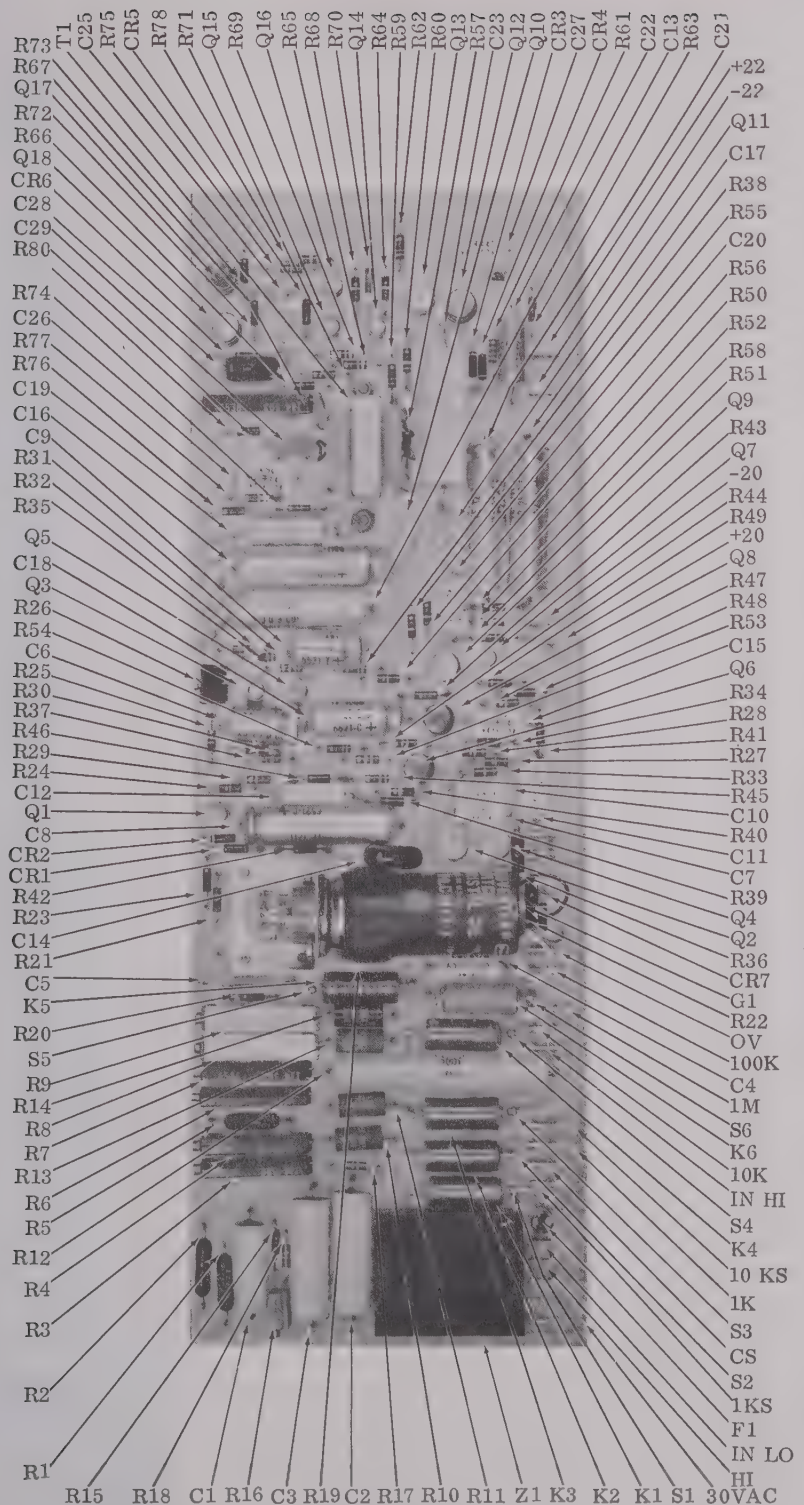
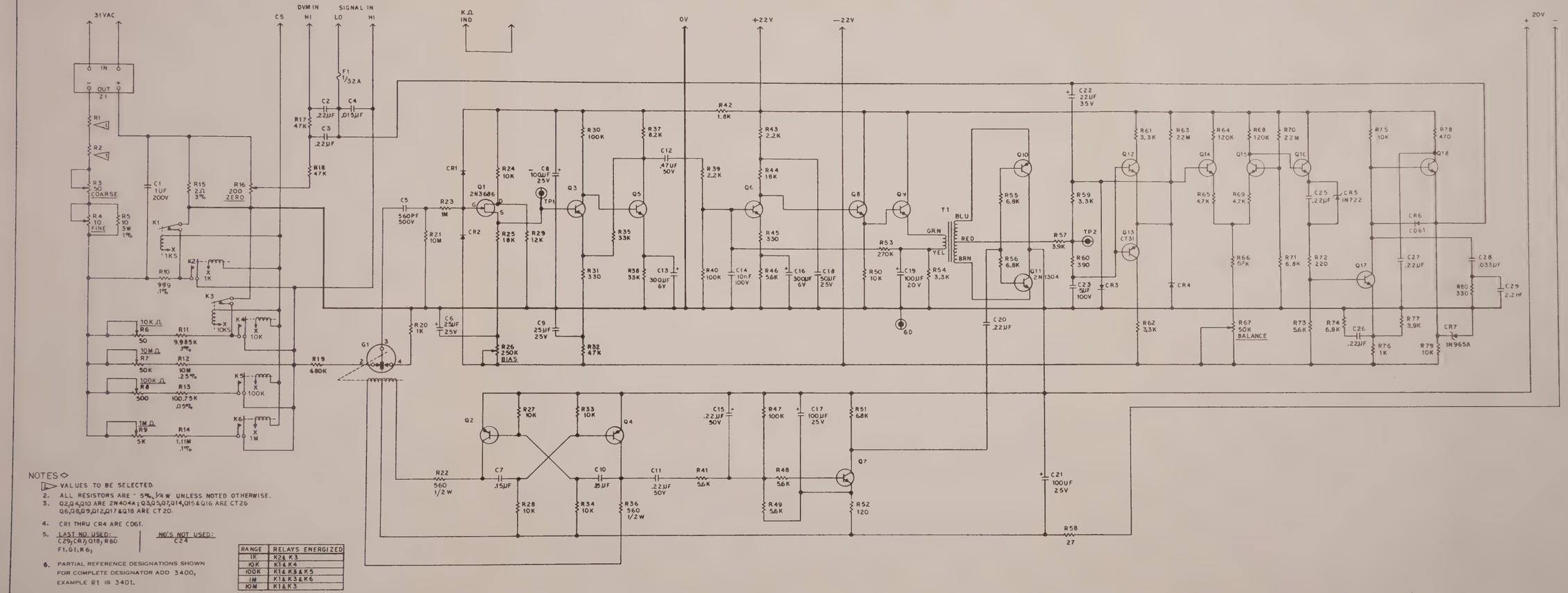


Figure 8D-1. Model 6990 Ohms Converter Plug-in Accessory.



NOTES ◇

1. ▷ VALUES TO BE SELECTED.
2. ALL RESISTORS ARE ± 5%, ¼ W UNLESS NOTED OTHERWISE.
3. Q2,Q4,Q10 ARE 2N404A ; Q3,Q5,Q7,Q14,Q15 & Q16 ARE CT26 Q6,Q8,Q9,Q12,Q17 & Q18 ARE CT20.
4. CR1 THRU CR4 ARE CD61.
5. LAST NO USED: C29,CR7,Q18,R80 F1,G1,K6; | NO'S NOT USED: C24
6. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR ADD 3400, EXAMPLE R1 IS 3401.

RANGE	RELAYS ENERGIZED
1K	K2 & K3
10K	K1 & K4
100K	K1 & K3 & K5
1M	K1 & K3 & K6
10M	K1 & K3

MODEL 6990

69-0734 DATE 8-23-66 REV B

DRAWING SIZE R

REV A ECN # 1608
REV B ECN # 1693

SCHEMATIC
OHMS—CONVERTER

EIMAC DIVISION

69-0734 REV B

APPENDIX

TABLE OF CONTENTS

Section	Page
ABBREVIATIONS	A-2
MANUFACTURERS	A-3
WARRANTY	

WORD	ABBREVIATION
alternating current	AC
ampere	A
atto 10^{-18}	a
bel	B
capacitor	CAP
carbon	CAR
centi 10^{-2}	c
ceramic disc	DISC
common	COM
composition	COMP
connector	CONN
cycles per second (hertz)	c/s
deci 10^{-1}	d
degree Celsius	^{o}C
degree Fahrenheit	^{o}F
degree Kelvin	^{o}K
deka 10^{1}	da
demodulator	DEMOD
deposited	DEP
digital voltmeter	DVM
direct current	DC
double pole double throw	DPDT
electrolitic	ELECT
encapsulated	ENCAP
farad	F
fast-up	f-up
femto 10^{-15}	f
fixed	FXD
germanium	Ge
giga 10^{9}	G
gram	g
ground	gnd
guard	grd
hecto 10^{2}	h
henry	H
hertz	Hz
hour	h
impedance	Z
indicator	IND
Joint Electronic Device Engineering Council	JEDEC
kilo 10^{3}	k
maximum	MAX
mega 10^{6}	M
metallized	MET
meter	m
mho (siemens)	mho

WORD	ABBREVIATION
micro 10^{-6}	u
milli 10^{-3}	m
miniature	MINI
minimum	MIN
minute	min
mylar	MY
nano 10^{-9}	n
neon	Ne
normally closed	NC
normally open	NO
note	*
ohm	Ω
paper	PAP
peak	P
peak to peak	PP
pico 10^{-12}	p
polarity	POL
polycarbonate	POLYCARB
polystyrene	POLY
position	POS
potentiometer	POT
pound	lb
receptacle	REC
resistor	RES
root-mean-square	rms
rotary	ROT
second	s
siemens	S
silicon	Si
silicon controlled switch	SCS
silver	sil
single pole double throw	SPDT
single pole single throw	SPST
spring	SPR
tantalum	TANT
tera 10^{12}	T
thermistor	THERM
trimmer	TRIM
value selected at factory	*
variable	VAR
volt	V
voltampere	VA
watt	W
with	w/
without	w/o
wire wound	WW

LIST OF MANUFACTURERS

CODE TO NAME

FEDERAL SUPPLY CODE	MANUFACTURER	ADDRESS
00648	Microtran Co., Inc.	Valley Stream, New York
00656	Aerovox Corp.	New Bedford, Massachusetts
01121	Allen Bradley Co.	Milwaukee, Wisconsin
01295	Texas Instruments, Inc.	Dallas, Texas
02567	International Electronics Industries, Inc.	Nashville, Tennessee
02872	Inland Electronics Corp.	Aurora, Illinois
02881	Amphenol-Borg Electronics Corp.	Chicago, Illinois
03614	Bussmann Mfg.	Los Angeles, California
03797	Eldema Corp.	Compton, California
04062	Elmenco Products Co.	New York, New York
04097	Dale Electronics, Inc. , Pacific Division	Burbank, California
05347	Ultronix, Inc.	San Mateo, California
05704	Alsc, Inc.	Glendale, California
06751	U S Semicon Div. of Nuclear Corp. of America	Phoenix, Arizona
07088	Kelvin Electric Co.	Van Nuys, California
07115	Corning Glass, Electronic Components	Bradford, Pennsylvania
07716	International Resistance Co.	Burlington, Iowa
08664	Bristol Co.	Waterbury, Connecticut
08806	Miniature Lamp Dept. G E. Co.	Cleveland, Ohio
09145	Aschim Electronics	Sun Valley, California
11237	Chicago Telephone of California, Inc.	Pasadena, California
12040	Elpac, Inc.	Fullerton, California
12617	Hamlin, Inc.	Lake Mills, Wisconsin
14099	Semtech Corp.	Newbury Park, California
14655	Cornell-Dubilier Electric Corp.	Newark, New Jersey
14752	Electro Cube, Inc.	South Pasadena, California
15818	Cimron Division of Lear Siegler, Inc.	San Diego, California
16179	Ameloo, Inc.	Los Angeles, California
17826	Techno-Components Corp.	Northridge, California
18736	Voltronics Corp.	Hanover, New Jersey
19701	Electra Manufacturers	Independence, Kansas
21226	Executone, Inc.	New York, New York
22045	Jordan Electronics	Van Nuys, California
28520	Heyman Mfg. Co.	Kenilworth, New Jersey
42190	Muter Company	Chicago, Illinois

FEDERAL SUPPLY CODE	MANUFACTURER	ADDRESS
49671	Radio Corporation of America	New York, New York
56289	Sprague Electric Company	North Adams, Massachusetts
71468	I. T. T. Cannon Electric Company	Los Angeles, California
71590	Centralab, Division of Globe Union, Inc.	Milwaukee, Wisconsin
72314	Fairchild Camera and Instrument Corp.	Syosset, L. I., New York
72825	Eby, Hugh H., Inc.	Philadelphia, Pennsylvania
73899	J. F. D. Electronics Corp.	Brooklyn, New York
75915	Littelfuse, Inc.	Des Plaines, Iowa
79094	Victory Engineering Mfg. Co.	Millvale, Pennsylvania
80294	Bourns Laboratories, Inc.	Riverside, California
83330	Smith, Herman H., Inc.	Brooklyn, New York
84171	Arco Electronics, Inc.	Great Neck, New York
90201	Mallory, P. R. and Co., Inc.	Detroit, Michigan
91662	Elco Pacific	Los Angeles, California
92379	Burroughs Corp.	Chicago, Illinois
95348	Gordos Corp.	Bloomfield, New Jersey
96733	San Fernando Electric	San Fernando, California
97704	Nu-Trim Division of Newport	Newport Beach, California
None Assigned	Technical Products Sales, Inc.	San Diego, California

MODEL NO. SERIAL NO.

IMPORTANT

Include the instrument model number and the serial number in any correspondence regarding this instrument. The above serial number must match the instrument serial number if parts are to be ordered from the manual. Your help in this will enable us to answer your inquiries and fill your order with the least possible delay.

WARRANTY

All CIMRON instruments are fully warranted to be free from defects in material and workmanship for a period of one year as per CIMRON's standard terms and conditions of sale. This warranty does not, however, cover tubes, transistors, choppers, fuses and/or batteries. Mechanical stepping switches are guaranteed for ninety days provided they have been lubricated in accordance with manufacturers instructions.

Should replacement parts be required, whether at no charge under warranty or at established net prices, notify us promptly, including sufficient details to identify the required parts. We will ship them (shipping charges collect) as soon as possible, usually within twenty-four hours.

In the event factory service or assistance is required for this instrument:

1. Give CIMRON's Customer Service Department prompt notice in writing of the nature of any suspected defects.

2. Upon receipt of written authorization and shipping instructions from CIMRON, return the instrument (TRANSPORTATION CHARGES PREPAID) to CIMRON's main plant located at 1152 Morena Boulevard, San Diego, California 92110.

3. CIMRON will acknowledge receipt of the instrument and indicate warranty status. No charge will be made for repairs covered by terms of this warranty.

4. In the event repairs are "out of warranty", CIMRON will provide the customer with a quotation which will require the customer's approval before the work can be accomplished. Return of the instrument to the customer shall be with TRANSPORTATION CHARGES COLLECT.

CIMRON reserves the right to adjust the prices and make design modifications without notice.

CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be tested as soon as it is received. If it does not operate or is damaged, a claim should be filed with the carrier. A copy of the claim should be sent to CIMRON. Upon receipt of the claim we will advise you of the disposition to be made of the instrument and arrangements will be made for repair or replacement. Do not return an instrument to CIMRON without prior approval.

The above statements and warranty constitute a part of our Standard Terms and Conditions of Sale as published in our order acknowledgement which is CIMRON's Warranty in its entirety.

MODEL NO. SERIAL NO.

IMPORTANT

Include the instrument model number and the serial number in any correspondence regarding this instrument. The above serial number must match the instrument serial number if parts are to be ordered from the manual. Your help in this will enable us to answer your inquiries and fill your order with the least possible delay.

WARRANTY

All CIMRON instruments are fully warranted to be free from defects in material and workmanship for a period of one year as per CIMRON's standard terms and conditions of sale. This warranty does not, however, cover tubes, transistors, choppers, fuses and/or batteries. Mechanical stepping switches are guaranteed for ninety days provided they have been lubricated in accordance with manufacturers instructions.

Should replacement parts be required, whether at no charge under warranty or at established net prices, notify us promptly, including sufficient details to identify the required parts. We will ship them (shipping charges collect) as soon as possible, usually within twenty-four hours.

In the event factory service or assistance is required for this instrument:

1. Give CIMRON's Customer Service Department prompt notice in writing of the nature of any suspected defects.

2. Upon receipt of written authorization and shipping instructions from CIMRON, return the instrument (TRANSPORTATION CHARGES PREPAID) to CIMRON's main plant located at 1152 Morena Boulevard, San Diego, California 92110.

3. CIMRON will acknowledge receipt of the instrument and indicate warranty status. No charge will be made for repairs covered by terms of this warranty.

4. In the event repairs are "out of warranty", CIMRON will provide the customer with a quotation which will require the customer's approval before the work can be accomplished. Return of the instrument to the customer shall be with TRANSPORTATION CHARGES COLLECT.

CIMRON reserves the right to adjust the prices and make design modifications without notice.

CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be tested as soon as it is received. If it does not operate or is damaged, a claim should be filed with the carrier. A copy of the claim should be sent to CIMRON. Upon receipt of the claim we will advise you of the disposition to be made of the instrument and arrangements will be made for repair or replacement. Do not return an instrument to CIMRON without prior approval.

The above statements and warranty constitute a part of our Standard Terms and Conditions of Sale as published in our order acknowledgement which is CIMRON's Warranty in its entirety.

LEAR SIEGLER, INC.

ELECTRONICS FOR MEASUREMENT – CONTROL – AUTOMATION